FINAL
RESIDENTIAL SOIL SAMPLING WORK PLAN

For the
Residential Study Area
Near the
Former Celotex Site
2800 South Sacramento Avenue
Chicago, Illinois 60623

Prepared for
Honeywell International Inc.

June 2006

Prepared by

CH2MHILL

QUALITY ASSURANCE PROJECT PLAN

RESIDENTIAL STUDY AREA NEAR THE FORMER CELOTEX SITE
Chicago, Illinois

Honeywell International Inc.

Prepared by: CH2M HILL

Date: June 2006

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Executive Summary

This work plan presents the proposed residential soil sampling approach and procedures that will be used to characterize the residential study area surrounding the former Celotex Corporation (Celotex) Site located at 2800 South Sacramento Avenue in Chicago, Illinois. The work plan has been prepared on behalf of Honeywell International Inc. (Honeywell). The location of the Main Site and residential sampling area are illustrated on Figures 1-1 and 1-2.

Previous actions associated with the Main Site and surrounding residential areas were conducted under a 1996 U.S. Environmental Protection Agency (USEPA) Region 5 Administrative Order by Consent (AOC). The 1996 AOC concluded with preparation of the required Engineering Evaluation/Cost Analysis (EE/CA). The EE/CA evaluated alternative removal actions pursuant to 40 Code of Federal Regulations 300.415 (b)(4)(I) and the Superfund Accelerated Cleanup Model (SACM) guidance. The EE/CA was approved by USEPA in 2004 and USEPA subsequently issued an Action Memorandum for the Site on March 7, 2005. The objective of this work plan is to gather further data within the residential areas surrounding the Site to support future decision-making and removal action planning.

The former Celotex Site was used for making, storing and selling asphalt-roofing products. Former operations at the 24-acre Main Site during the approximate period of 1911 to 1989 resulted in the release of polycyclic aromatic hydrocarbons (PAHs) in the air. It is possible that PAH compounds may have migrated through airborne dispersion beyond the Celotex site boundaries and may be present in surface soils in some residential areas surrounding the Site. Facility closure and demolition of the Main Site and subsequent actions have removed the previous source area such that no ongoing releases from the site exist.

Three residential sampling events were conducted between 1995 and 1999 under USEPA-approved work plans. Surface soil samples were collected from a subset of the residential properties surrounding the Site during these events. The objectives were to obtain data to support risk assessment and background evaluations. Elevated levels of PAHs were documented within some of the residential soils. However, to further define the area of impact in support of removal action planning, additional sampling is necessary.

USEPA has defined the residential area requiring sampling as within the boundary set by Whipple Avenue, Sacramento Avenue, 28th Street, and 26th Street. In addition, Honeywell has voluntarily agreed to perform sampling within a larger area, although no connection has been made between these areas and the site to date. The residential properties proposed to be sampled within this work plan are bounded by 26th Street to the north, Kedzie Avenue to the west, 31st Street to the south, and the Sacramento Avenue to the east. This area is referred to as the "residential study area".

Sampling within this study area will be conducted exclusively at residential properties. Parkways in particular are being excluded from sampling due to the likelihood for high bias associated with these areas being used for roadway snow accumulation. Snow melt would

likely deposit asphalt particulate, which would increase the PAH concentrations in surface soil. Although the parkways will not be sampled, if residential lots near a particular parkway are identified for remedial action, the parkway will be considered for remedial action as well.

Prior to soil sampling, all residential homeowners within the study area will be contacted to discuss the purpose of the sampling, describe the sampling program, and obtain access agreements. This activity will be lead by Honeywell with support from USEPA.

Soil within areas with exposed surface and shallow subsurface soil will be sampled. The sampling rationale used in this investigation adopts the five sampling points for a 5,000 square feet (or less) surface area as described in the USEPA August 2003 "Superfund Lead-Contaminated Residential Sites Handbook" modified to reflect the smaller lot and exposed surface area conditions within the residential study area. Each property will have 5 locations sampled; 1 to 2 locations from the front yard and 3 to 4 locations from the backyard based on exposed soil areas.

Surface soil samples will be collected from the 0 to 6-inch depth interval. Although the potential impacts associated with the Celotex Site would have been deposited onto surface soils through airborne dispersion, shallow subsurface soil samples are also being collected to guide decision-making. To evaluate the vertical extent of PAHs, shallow subsurface soil samples will be collected from the 6 to 24-inch and 24 to 36-inch depth intervals. The depth intervals (or portions of depth intervals) in yards previously sampled by the Illinois Environmental Protection Agency or previous contractors will not be re-sampled during this investigation. The depth intervals not sampled previously will be sampled to evaluate vertical extent of PAHs.

Composite samples from each depth interval will be collected to support a yard-specific result. One composite sample from each of the three depth intervals will be collected from both the front yard and backyard of each residential property. If a small side yard is present, it will be combined with the smaller of the front or back yard and sampled as part of that five-point composite. Sample aliquots from the boring locations in each yard will be combined to form the composite sample from each depth interval in each yard.

Vacant residential lots will be sampled with five borings distributed across the entire lot with one composite sample collected from each depth. If an occupied lot and the adjacent vacant lot are owned by the same person(s) or entity, it will be sampled as two individual lots, with one composite sample from each depth interval obtained from the front and back yard of the occupied lot and one composite sample obtained from the each depth interval from the adjacent vacant lot.

All soil samples will be analyzed for polycyclic aromatic hydrocarbons using the USEPA Test Methods for Evaluating Sold Waste, Physical/Chemical Methods, SW846, Method 8270C, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry. The results will be evaluated through calculation of the benzo(a)pyrene equivalent {B(a)P EQ} concentration in accordance with USEPA-approved procedures.

Upon completion of the residential soil sampling proposed herein, a Residential Sampling Report will be developed to document the results of the investigation. The report will be

prepared in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidance and will be submitted to USEPA.

Contents

Acronyms and Abbreviations

AOC	Administrative Order by Consent
B(a)P EQ	Benzo(a)pyrene Equivalents
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DQO	data quality objective
EE/CA	*Engineering Evaluation, Cost Analysis*
ERM	Environmental Resources Management Group
FSP	field sampling plan
HSP	Health and Safety Plan
ISGS	Illinois State Geological Survey
MS	matrix spike
MSD	matrix spike duplicate
PAH	polycyclic aromatic hydrocarbons
PPM	parts per million
QAPP	Quality Assurance Project Plan
QA	Quality Assurance
QC	Quality Control
RASAP	Residential Area Sampling and Analysis Program
SACM	Superfund Accelerated Cleanup Model
SAP	Sampling and Analysis Plan
sf	Square Feet
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

SECTION 1

Introduction

This work plan presents proposed residential soil sampling activities for the areas surrounding the Former Celotex Site located at 2800 South Sacramento Avenue in Chicago, Illinois (the Site), on behalf of Honeywell International Inc. (Honeywell). Analytical results from this investigation will be used to support decision-making related to residential remedial actions. The location of the Main Site and residential sampling area are illustrated on Figures 1-1 and 1-2.

This work plan provides a general description of the tasks that will be performed to complete the investigation phase of the residential soil sampling. Health and safety requirements and procedures for the work are presented in the Health and Safety Plan (HSP). Detailed descriptions of field activities, sampling equipment, analysis procedures, quality assurance protocols, are presented in the Sampling and Analysis Plan (SAP). The SAP is subdivided into the following two parts:

- **Field Sampling Plan (FSP) -** specifies the procedures that will be utilized to implement field activities and sample collection
- **Quality Assurance Project Plan (QAPP) -** identifies the data quality objectives (DQOs), analytical requirements, and quality assurance/quality control (QA/QC) processes that will be implemented to generate defensible data

This related information is not repeated in this work plan, rather is contained in the respective appendices. HSP is included in Appendix A, the SAP in Appendix B.

1.1 Objectives of the Residential Sampling Program

The residential sampling will be completed in accordance with the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and will follow the interim final *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (U.S. Environmental Protection Agency (USEPA), 1988).

The primary objectives of the residential sampling investigation are to:

- Implement a field data collection program to further define the extent of polycyclic aromatic hydrocarbons (PAH) impacts within surface soil and shallow subsurface soil at residential properties surrounding the site,
- Characterize residential properties on a lot-specific and depth-specific basis to support removal action planning based on benzo(a)pyrene equivalent concentrations,
- Prepare a Residential Sampling Report to document the results of the investigation.

1.2 Project Organization

Following USEPA approval, CH2M HILL will be the lead engineer responsible for implementing the residential soil sampling proposed within this work plan under the direction of Honeywell. Communications will occur regularly among Honeywell, CH2M HILL, and USEPA with the following key points of contact as follows:

- USEPA Remedial Project Manager - Ms. Rosita Clarke-Moreno
- Honeywell Remediation Manager - Mr. Chuck Geadelmann
- CH2M HILL Project Manager - Mr. Joel Wipf

1.3 Organization of the Work Plan

This Residential Sampling Work Plan is organized as follows:

Section 1, Introduction, provides general background information regarding the residential soil sampling, summarizes the objectives of the investigation, and outlines the project and work plan organization.

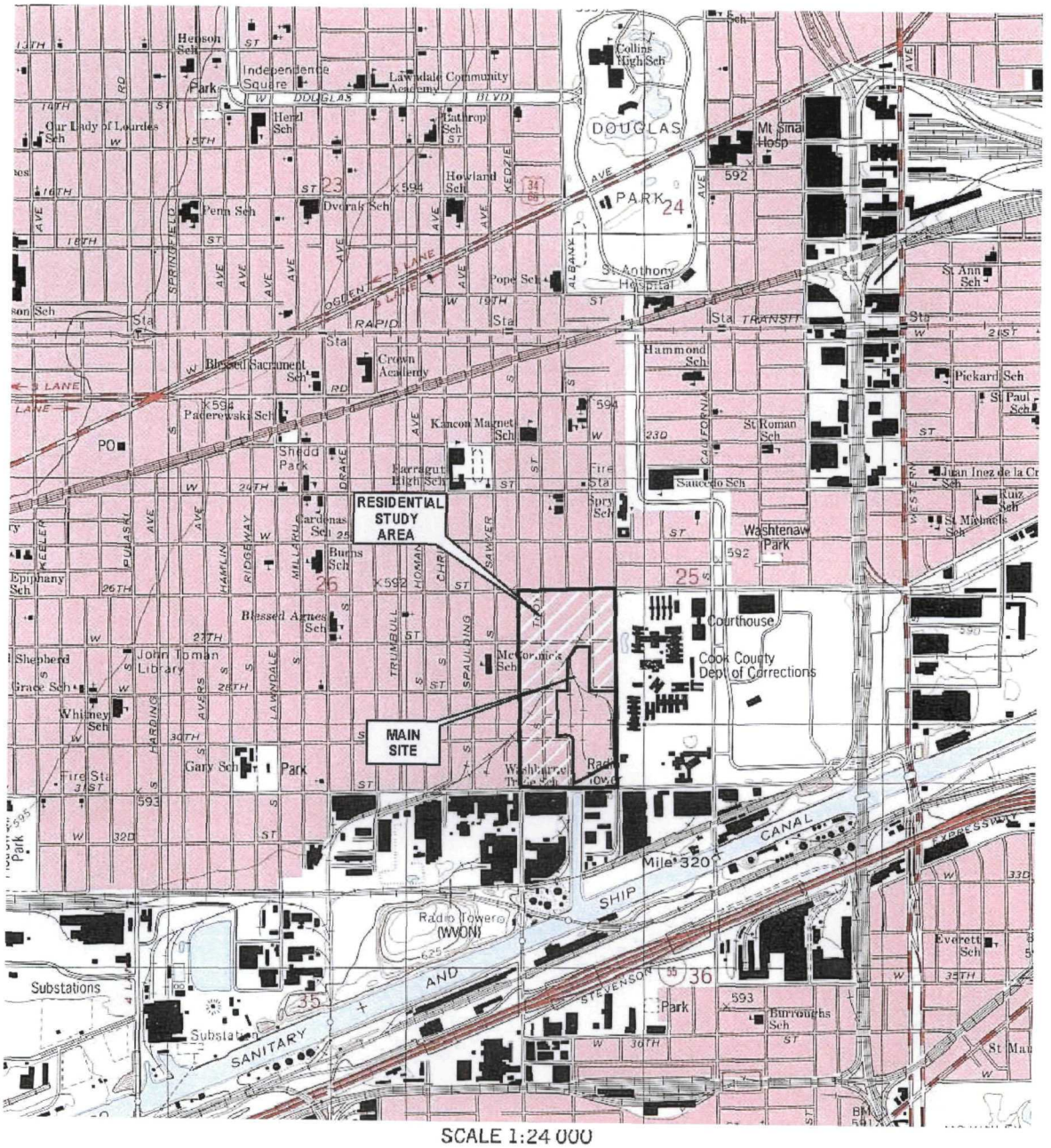
Section 2, Site Background and Physical Setting, provides an overview of the location and history of the site, summarizes previous investigations, and identifies information concerning the physical setting of the study area.

Section 3, Residential Sampling Rationale and Investigation Procedures, identifies the objectives and describes the proposed residential area sampling and analysis program (RASAP). These descriptions include site-specific residential sampling tasks adapted from the detailed tasks identified in the FSP and QAPP.

Section 4, Residential Sampling Report, presents the general outline of the residential soil sampling report.

Section 5, Project Schedule, presents the anticipated residential sampling schedule based on the scope of the project, and identifies key activities and delivery dates.

Section 6, References, presents a listing of works referenced during compilation of the Residential Soil Sampling Work Plan.



SCALE 1:24 000

1 0.5 0 KILOMETERS 1 2

1000 0 METERS 1000 2000

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MILES

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

FEET

Quadrangle Location

NORTH

Source: U.S.G.S. 7.5-Minute Quadrangle for Englewood, Illinois, 1997

E327757.CE.10.1 Fig_1-1_Celotex_042106_w4 06-19-06 lg/jls

Figure 1-1

Site Location and Study Area
Residential Soil Sampling Work Plan
Former Celotex Site
Chicago, Illinois

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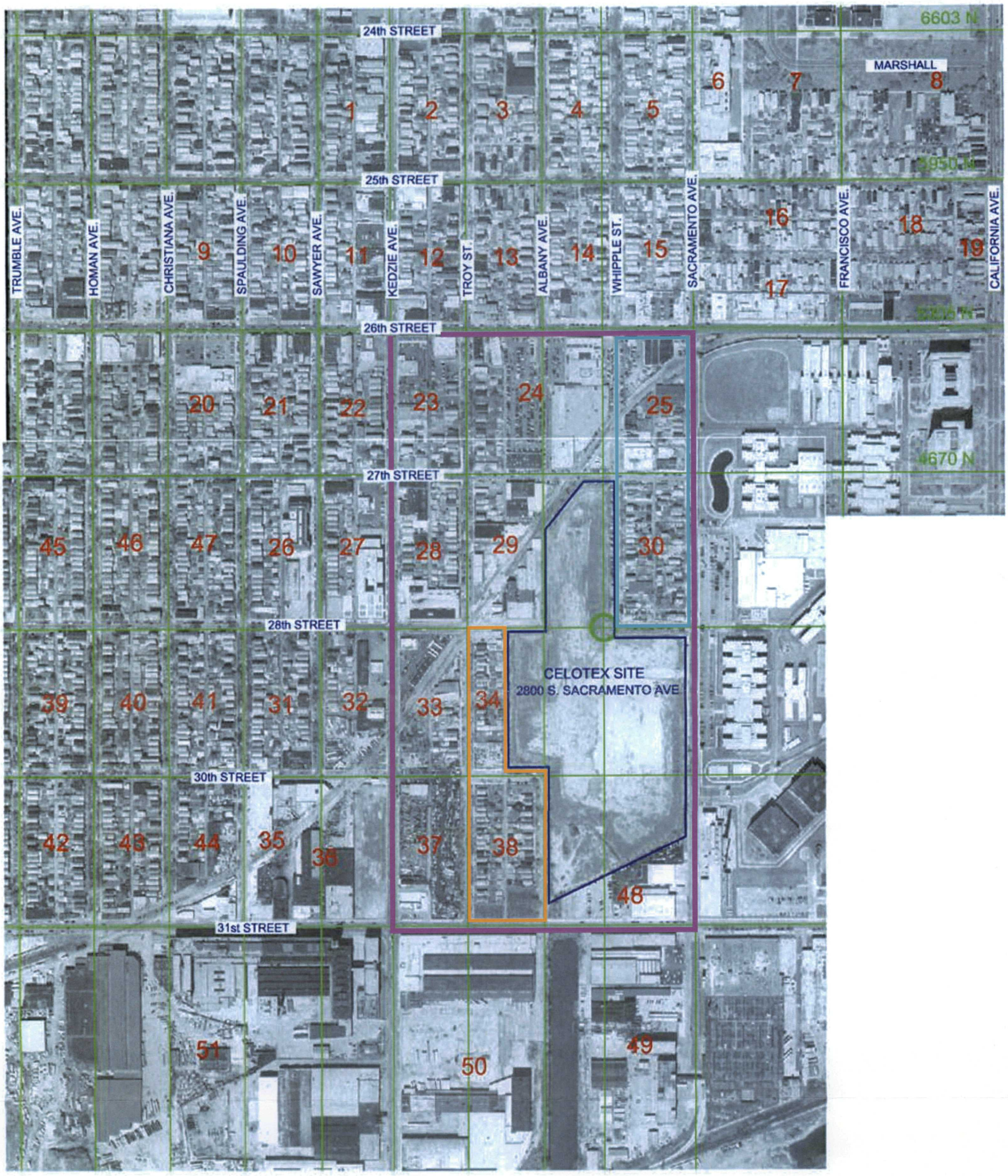

LEGEND

27	Block Number
	Northing and Easting Lines
	Main Site
	Northeast Residential Area
	Southwest Residential Area
	Residential Sampling Area

NOTE: Soil sampling within the Northeast and Southwest Residential Areas is required by USEPA. Honeywell has voluntarily agreed to perform residential soil sampling within the larger area identified as the Residential Study Area.

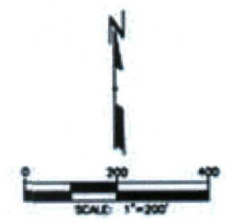

Figure 1-2
Aerial Photograph
Residential Soil Sampling Work Plan
Former Celotex Site
Chicago, Illinois

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SECTION 2

Site Background and Physical Setting

This section summarizes the available information on the residential study area to be investigated further under this Residential Soil Sampling Work Plan. This information was obtained from previous reports prepared for the Celotex site and the surrounding residential area, and includes subsections describing the site setting, regional and site-specific geology and hydrogeology, and previous investigations.

2.1 Site Setting

The subject residential study area consists of the property within an area bounded by 26th Street to the north, Kedzie Avenue to the west, 31st Street to the south and Sacramento Avenue to the east. The United States Geological Survey (USGS) reference for the Celotex site location indicates that it is situated in the West 1/2 of the Southwest 1/4 of Section 25, Township 39 North, Range 13 East of the Third Prime Meridian on the Englewood 7.5 Minute Quadrangle. The residential area encompasses approximately 58 acres not including the former Celotex site, which consists of 22 acres formerly owned by The Celotex Corporation (Celotex) and currently owned by Sacramento Corporation, and a 2-acre parcel to the south sometimes referred to as the Palumbo parcel and currently owned by Monarch Asphalt (Monarch).

The Site is situated amidst a multi-use area that includes residential, commercial, manufacturing, governmental, and industrial establishments. The Cook County Correctional Facility is located east of the Main Site, on the east side of Sacramento Avenue and the former Atkinson, Topeka & Santa Fe railroad line crosses a portion of the area to the northwest. Residential and commercial properties are located north and west of the site and industrial property is located to the south. The Chicago Sanitary and Ship Canal is located approximately 1,500 feet south of the Site.

The Celotex site formerly housed several manufacturing-related buildings including a large warehouse, smaller storage sheds, an enclosed tank area, and an office building. All buildings and former facility features have been demolished and a soil cover was placed subsequent to demolition. The Main Site is currently surrounded by a chain-link fence with a single entrance located at the main gate on Sacramento Avenue. In 2002, Sacramento Corporation bought the 22-acre portion of the Celotex property and placed approximately 2 feet of gravel on the Main Site for parking trucks.

2.2 Geology and Hydrology

In 1990, the Illinois State Geological Survey (ISGS) researched information on the geology and hydrology of the area in which the residential area is located (Parsons, October 1997). The information provided by the ISGS includes the following: "Subsurface deposits to bedrock, as described in ISGS Circular 542, 'Stack-Unit Mapping of Geological Materials (Berg and Kempton, 1988) consists of a discontinuous deposit of the Equality Formation, specifically the

Carmi Member. This is a deposit consisting primarily of silts and clays. This material overlays a greater than 20-foot thick deposit of the silty and clayey diamictons of the Wedron Formation. Bedrock in this region is primarily Silurian dolomite, although there are also some Devonian-age dolomite. Bedrock is located within 20 to 50 feet of the surface in the northern two-thirds of section 25. These materials vary in permeability.

"Aquifers in the area of interest are developed in the Upper Bedrock and Mississippi Valley aquigroups, as detailed in 'ISGS Cooperative Groundwater Report 10, Geology, Hydrology and Water Quality of the Cambrian and Ordovician Systems in Illinois, Visocky, Sherrill and Cartwright, 1985.' There is no available information from well logs in section 25 from the ISGS. There are, however, two well logs from the northwest quarter of section 30-T39N-R14E, the section located east of 25-T39N-R13E. These logs indicate that water is obtained from limestone at an average depth of 79 feet beneath the surface.

"Depth to the water table is variable and generally shallow; within 6 to 10 feet of the surface where undisturbed, but may vary considerably over/in disturbed areas. The topographic map of the region indicates that this area is highly developed and has been since at least the 1920s (USGS Topographic Map, 7.5-minute series, Englewood Quadrangle, 1929, 1963 photo revised 1972, 1980). Soil survey and wetlands map information indicate marshy conditions, this area has a seasonal high water table and wetness is a severe limitation which is difficult to overcome (U.S. Department of Agriculture Soil Survey of DuPage and Parts of Cook Counties, 1979; Englewood Quadrangle, 1984, U.S. Department of the Interior, 7.5-minute series. National Inventory Map).

"Direction of groundwater flow in the area is unknown, but usually mimics the flow of surface water in the area. Since this area is highly developed, local groundwater flow may wane considerably from that observed on the surface. Groundwater, however, will tend to flow southeast, in the direction of the South Branch of the Chicago River and Lake Michigan."

Site-specific geologic and hydrogeologic information was collected during the Main Site investigation and confirmed the regional characteristics of the subsurface in the area (Parsons, 1997). The subsurface deposits consisted primarily of silts and clays. The surface material consisted of brown to dark brown-colored silty clays with gravel, sand, and the intermittent presence of construction debris. The thickness of the surface fill material ranged from 0.5 to 2 feet. The surface fill material was underlain by a lower layer of fill material that consisted of clay, silts, sands, gravel, construction materials, rail ties, cinders, tar/asphalt, and concrete. The thickness of the lower fill material ranged from 0.5 to 20 feet. The lower fill material was underlain by olive-brown colored silty clay with gravel and sand followed by gray to dark gray colored silty clay. Within the fill there were also occasional pockets of silt or sand. The thickness of the clay layer ranged from 1.5 to 16 feet.

Several borings indicated the presence of peat interbedded with fine sand at thicknesses ranging from 2 to 18 feet in borings located near the southeast side of the Celotex site. This peat/sand combination is believed to be native materials of the Equality Formation.

During drilling operations performed as part of the field investigation program, water was encountered in isolated areas in minimal quantity. The depth to water was also highly variable over the entire site. Groundwater exists generally in isolated pockets, usually associated with fill materials. Fill and native soils tended to be low permeability clays and silty clays. Porous

materials like sand and gravel, most often tended to be unsaturated. Because of these conditions, it is believed that within a depth of 20 to 25 feet, subsurface water exists only in isolated pockets and not within a continuous flow zone. Attempts to sample groundwater within this depth range were hampered by the scarcity of saturated materials beneath the site. Temporary well points installed as part of the field investigation experienced little or no groundwater accumulation or recharge; therefore, groundwater flow direction could not be defined.

2.3 Previous Investigations

Prior to execution of the 1996 Administrative Order of Consent (AOC), Environmental Resources Management-North Central, Inc. (ERM) executed a RASAP that encompassed over 100 soil samples collected from 57 residential properties located at varying distances from the Site (ERM, 1995). Composited surface soil samples were collected from each sampled property. Benzo(a)pyrene equivalent {B(a)P EQ} concentrations ranged from approximately 0.7 to 9 parts per million (ppm).

Following execution of the November 1996 AOC, the Phase II and III residential area investigations were performed based on the "Residential Area Conceptual Work Plan" (Parsons, May 1997). The findings and analytical data from these investigations are presented in the "Draft Phase II Residential Area Sampling Report," (Parsons, August 1998), and the "Draft Phase III Residential Area Sampling Report, "(Parsons, June 1999). The information and data presented in these reports is extensive and has not been repeated in this work plan. The key scope and findings are as follows:

- Eight grab soil samples were collected from 8 residential properties located to the northeast of the Main Site from the 0 to 3 inch depth interval.
- Six residential properties located within an area designated as background were also sampled similarly.
- Median B(a)P EQ concentrations were calculated for each property and evaluated from a statistical standpoint.
- Median B(a)P EQ concentrations in the northwest ranged from approximately 3.6 ppm to 35 ppm.
- Median B(a)P EQ concentrations in other areas ranged from approximately 0.5 to 2.9 ppm.

The Engineering Evaluation and Cost Analysis (EE/CA) report (Parsons, 2004) was prepared to fulfill provisions in the 1996 AOC that required the Respondents to conduct an EE/CA to evaluate alternative removal actions pursuant to 40 Code of Federal Regulations 300.415 (b)(4)(I) and the Superfund Accelerated Cleanup Model (SACM) guidance. The EE/CA is the USEPA-specified remedial alternatives analysis mechanism for evaluating non-time-critical removal actions under SACM. The findings and data presented in the residential sampling reports form the basis for the evaluation of remedial alternatives presented in the EE/CA report.

SECTION 3

Residential Soil Sampling Rationale and Investigation Procedures

This section details the proposed sampling, technical approach, and investigation methodologies that will be used to perform the residential soil sampling in the study area near the Celotex site. Details regarding health and safety requirements and field sampling procedures are addressed in the HSP (Appendix A) and SAP (Appendix B), respectively.

3.1 Sampling Rationale

Data collected previously during the Phase I, II, and III residential sampling and any new data collected as part of this residential sampling effort will be used for the following purposes:

- To assess the level of PAH impact on each residential property within the study area
- To assist in decision-making for the residential study area

The following property types will be sampled:

- Occupied residential property
- Unoccupied residential property
- Vacant lots adjacent to residential property with evidence of child or adolescent recreational use
- Vacant lots zoned for residential use

The following property types will not be sampled:

- Commercial property
- Parkways (the landscaped/grassed area between the residential sidewalk and street)
- Alleyways, paved and unpaved
- Vacant lots adjacent to commercial or industrial property
- Vacant lots zoned for industrial or commercial use
- Other nonresidential property

USEPA has defined the residential area requiring sampling as within the boundary set by Whipple Avenue, Sacramento Avenue, 28th Street, and 26th Street. In addition, Honeywell has voluntarily agreed to perform sampling within a larger area, although no connection has been made between these areas and the site to date. The residential study area proposed for sampling by this work plan is contained within the boundaries of 26th Street to the north, Kedzie Avenue to the west, 31st Street to the south and Sacramento Avenue to the east. The location of the residential sampling area is illustrated on Figures 1-1 and 1-2. The current

estimated number of residential property lots present in this residential study area is 179, inclusive of properties that have been sampled within this area previously. Although these additional areas are not expected to have been impacted by the former Celotex operations and do not require sampling by USEPA, Honeywell has proactively agreed to sample this larger area to obtain further data in support of decision-making.

The USEPA's August 2003 "Superfund Lead-Contaminated Residential Sites Handbook" (the "Handbook") is often recommended as a guidance document for residential sampling programs, whether you are sampling for lead or other constituents. As a baseline, the Handbook recommends five sampling points, based on a 5,000 square feet (or less) surface area with a composite sample collected from aliquots of the same depth interval in each of the 5 borings. The sampling rationale used in this investigation adopts the 5 sampling points for collecting composite samples from each depth interval, as described in the Handbook, modified to reflect the residential lot size and exposed surface areas present in the study area, as described below.

The properties in the residential study area are smaller with less exposed surface area than the representative lots in the EPA guidance document. Based on the information available from previous residential sampling, the average lot size is approximately 3,000 square feet (sf) with an average exposed soil area 1,000 sf. In addition, the front yards are generally smaller than the back yards.

Due to the smaller size of the residential study area lots and the smaller exposed soil areas, this study will use a total of 5 sampling points for each property; with 1 to 2 locations in the front yard and 3 to 4 in the backyard. If a small side yard is present, it will be combined with the smaller of the front or back yard and sampled as part of the front or back yard composite. This is a reasonable rationale for sampling based on the actual yard size and exposed surface areas present in the residential study area while generally following the Handbook guidance. This rationale will sample a smaller area with the same number of borings that the Handbook guidance recommends for a larger area.

Vacant residential lots will be sampled with five borings distributed across the entire lot. One composite sample from each depth interval will be collected from the 5 borings drilled at the vacant residential lot. If an occupied lot and the adjacent vacant lot are owned by the same person(s) or entity, it will be sampled as two individual lots, with one composite sample from each depth interval obtained from the front and back yard of the occupied lot and one composite sample obtained from the each depth interval from the adjacent vacant lot.

Surface soil samples will be collected from the 0 to 6 inch depth interval. Although the potential impacts associated with the Celotex Site would have been deposited onto surface soils through airborne dispersion, shallow subsurface soil samples are also being collected to guide decision-making. To evaluate the vertical extent of PAHs, shallow subsurface soil samples will be collected from the 6 to 24 inch and 24 to 36 inch depth intervals. Sample aliquots from the five boring locations in each yard will be combined to form the composite sample from each depth interval. The depth intervals (or portions of depth intervals) in yards previously sampled by the Illinois Environmental Protection Agency or previous contractors will not be resampled during this investigation. The depth intervals not sampled previously will be sampled to evaluate vertical extent of PAHs.

Sampling within this study area will be conducted exclusively at residential properties. Parkways in particular are being excluded from sampling due to the likelihood for high bias associated with these areas being used for roadway snow accumulation. Snow melt would likely deposit asphalt particulate, which would increase the PAH concentrations in surface soil. Although the parkways will not be sampled, if residential lots near a particular parkway are identified for remedial action, the parkway will be considered for remedial action as well.

The proposed data collection scheme in this work plan is designed to ensure that it meets the residential sampling DQOs in accordance with USEPA Region 5 requirements for site investigations following CERCLA guidance. Details of data analysis are included in Section 3.8. The project schedule is included in Section 5.

3.2 Site Access

Site access will be obtained following completion of a draft work plan. The process of obtaining access to the residential properties will be lead by Honeywell with support from USEPA. Support from the City of Chicago, the local community, government officials, and organized community groups may be sought out for assistance in obtaining access.

3.3 Property Information

Prior to the start of field sampling activities, information on the individual properties will be obtained utilizing the past investigation data and available data sources, such as Chicago City Directories, telephone directories, and the Cook County Assessor's Office records accessible from Residential Assessment Search Page located at the Cook County Assessor's Office Interactive Website (http://www.cookcountyassessor.com/ccao/startres.html), as warranted.

3.4 Sampling Activity

Once signed access agreements are obtained, sampling activities will be scheduled and conducted. Each property will be visited to collect site information, develop an address-specific sampling plan, and collect soil samples. A site checklist will be utilized to obtain and document information collected for each property, including any input from property owners. During the site visit, the proposed sampling activity will be described and explained to the owner and occupants. The information to be recorded during the site visit includes:

- Type of Property (fenced or open vacant lot, single family residential, multi-family residential/apartment)
- Occupancy
- Any access obstructions to the areas to be sampled (such as gates, fences, stairs, narrow passages between structures, or landscaping)
- If the owner/occupant has knowledge of the location of underground utility lines (water/sewer laterals, water meter, decorative lighting power lines, landscape sprinklers, etc.) on the property
- Property boundaries

- Lot dimensions and shape
- Alley access
- Alley Type and pavement present
- Number and type of structures present on property
- Location and size of paved areas
- Visible (overhead) or marked utilities
- Type and size of exposed soil areas (grass, weeds, bare soil, landscaped areas, gardens, planters, gravel-covered areas)
- Any areas that should not be sampled due potential contamination from other sources
- Any areas that the property owner does not want disturbed

A scaled plan will be created for each property visited or sampled. The information gathered will be used to guide the investigation and assist planning of any future activities.

Prior to any onsite activity, a utility locate request will be submitted for each property. Sampling will not be conducted until the utility locate waiting period has been completed. The property owner will be contacted in person or by telephone to schedule the date and time for sampling.

Sampling at each property will proceed through the same general sequence of steps based on safe work practices and procedures, required soil sampling methods and procedures and minimal disruption and noise to the property occupants and neighborhood. The steps outlined here may be changed due to address-specific characteristics, scheduling, access, and other factors. The sampling crew will work with the property occupants to minimize time and impact to each property. The steps expected during the sampling activities are as follows:

- Upon arrival at each property, the address on the access agreement will be confirmed.
- The field crew will determine if the property can be, and is safe, to enter. If the property can not be entered, the owner will be contacted to determine if the conditions can be changed to allow entry.
- The occupants of the property will notified of the start of the sampling activity and the procedure to be used will be explained to the satisfaction of the owner/occupant.
- If a site visit was previously conducted, the information obtained at that time will be confirmed. If no site visit has been conducted, the property conditions will be recorded as described above.
- Using the available site information, the number and locations of soil borings will be determined and marked. The locations will be shown to the owner or occupant to determine if they are acceptable. Locations will be adjusted at the request of the owner. Each property will have a minimum of five locations sampled; with 1 to 2 locations selected from the front yard and 3 to 4 locations from the back yard.
- The boring locations and surrounding area will be photographed or videotaped to document pre-sampling conditions.

- The field crew will confirm that the utility locate was conducted and all utility markings are present. No sampling activity will be conducted until the utility locate is completed.
- The work area, exclusion zone and decontamination areas will be established.
- The sampling equipment will be moved to the first sampling location. If a portable Geoprobe® is used, the hydraulic lines to the power system will placed as not to damage the property. Cones, barricades and hose bridges/cable protectors will used when the Geoprobe hydraulic lines cross sidewalks or established pedestrian routes.
- Hand equipment will be used if the Geoprobe® or power equipment can not be used due to access limitations.
- Wood planking or ramps will be used when the Geoprobe® is placed on or moved over soft ground to minimize rutting or moved over stairs.
- Once all the preparations are complete and the field crew is satisfied that is safe, the Geoprobe or power auger equipment will be started. Both equipment types use gasoline engines that are similar in the sound and exhaust fumes produced by large lawn mowers. The Geoprobe power system unit will, in most cases, be parked inside the equipment trailer in the street or on the grassed area next to the street.
- Soil sampling will start using the power equipment. The Geoprobe® sampling equipment will make a loud noise similar to rapid hammering of two metal objects together when the sample is driven into the ground and pulled out.
- The hand equipment does not produce significant noise.
- Once the sample is removed from the ground, the soil will be placed in containers, and described. The sampling equipment is decontaminated, and moved to the next sampling location and the next sample is collected using the same methods as the first.
- The power equipment engines may be stopped or left running between sample locations. The engines will be stopped after the last sample is collected on each property.
- After the last sample is collected, everything brought on the property will be removed, including the sampling equipment, trash, and decontamination equipment.
- The 3-foot deep holes in the ground from the sample collection will be refilled with any extra soil from the sample collection activities, topped off with topsoil purchased from a local garden shop or home store and hand compacted to minimize settling. The sod plug or other ground plug removed from each sample location will be replaced.
- A portable Global Positioning System unit will document the completed boring locations after the fieldwork is completed.
- Any property damaged during the sampling activities will be repaired on the spot or the property owner will be notified to arrange for repair or replacement.

- Photographs of the boring locations and surrounding property, including the paths taken by the Geoprobe® across the property will be photographed or videotaped to document post-sampling conditions.
- The owner will be notified by the sampling team once all the activities and cleanup and restoration are completed and they are ready to leave the property.

Composite soil samples will be collected from unpaved, grassed, bare soil, landscaped, garden, overgrown, and unimproved areas of each residential property. Typical residential lots with a front and back yard will be sampled using 5 soil borings, with 1 to 2 drilled in the front yard and 3 to 4 in the backyard, distributed evenly across each yard. If a small side yard is present, it will be combined with the smaller of the front or back yard and sampled. A schematic soil sample location layout for a standard residential property is provided as Figure 3-1.

Surface soil samples will be collected from the 0 to 6 inch depth interval with shallow subsurface soil samples also collected from the 6 to 24 inch and 24 to 36 inch depth intervals. Sample aliquots from the boring locations in each yard will be combined to form the composite sample from each depth interval.

Vacant residential lots will be sampled with five borings distributed across the entire lot. One composite sample from each depth interval will be collected from the 5 borings drilled at the vacant residential lot. If an occupied lot and the adjacent vacant lot are owned by the same person(s) or entity, it will be sampled as two individual lots, with one composite sample from each depth interval obtained from the front and back yard of the occupied lot and one composite sample obtained from the each depth interval from the adjacent vacant lot.

If refusal is encountered at a proposed boring location, a second boring will be attempted within two to five feet of the original assuming access and utility clearance allows. If refusal is also encountered at the second location, available depth intervals will be sampled if possible or the location will be excluded from the five-point composite sample.

Boring locations will be selected in a consistent manner for each similar property layout. Additional detail on the sampling program is contained in the FSP.

3.5 Sampling Equipment Decontamination

All non-disposable sampling equipment will be decontaminated after each use. The applicable methods for the decontamination of personnel and equipment are presented in the FSP.

3.6 Electronic Deliverable File Format

An offsite independent laboratory will analyze the samples collected for the residential sampling and will tabulate the results in an electronic format specified by the QAPP. The data validator will add data validation qualifiers. CH2M HILL will receive an electronic file from the laboratory that will facilitate downloading into a database. CH2M HILL will enter the validation flags into the database and perform a QA review to ensure viability and completeness of the database along with a concurrence check between the hard copies and the electronic data deliverables.

3.7 Sample Analysis and Validation

The analyses of the soil samples will be conducted at a contracted independent laboratory. All soil samples will be analyzed for polycyclic aromatic hydrocarbons using the USEPA Test Methods for Evaluating Sold Waste, Physical/Chemical Methods, SW846, Method 8270C, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry. The specific compounds to be reported consist of the following seven PAHs that contribute to the benzo(a)pyrene equivalent {B(a)P EQ} concentration:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenz(a,h) anthracene
- Indeno(1,2,3-cd)pyrene

The contracted independent laboratory will have provided their method detection limit to CH2M HILL in advance of sampling implementation so that a comparison can be made between QAPP requirements and the best available technology from the laboratory. The laboratory must follow the scope of work prepared by CH2M HILL. A signed certificate of analysis will be provided with each laboratory data package, along with a certificate of compliance certifying that all work was performed in accordance with the required analytical methods. Analyses will include the proper ratio of field QC samples recommended by the QAPP for the DQOs.

CH2M HILL will be responsible for tracking sample analysis and obtaining results from the independent laboratory. Data validation of the analytical data generated during the field program will be patterned after the USEPA *Contract Laboratory National Functional Guidelines for Organic Data Review* (1999). Areas of review include (when applicable to the method) holding time compliance, calibration verification, blank results, matrix spike precision and accuracy, method accuracy as demonstrated by laboratory confirmation samples, field duplicate results, surrogate recoveries, internal standard performance, and interference checks. A data review worksheet will be completed for each method of each data package and any non-conformance will be documented. This data review and validation process is independent of the laboratory's checks and focuses on the usability of the data to support the project data interpretation and decision-making processes. Additional data requirements are contained in the QAPP.

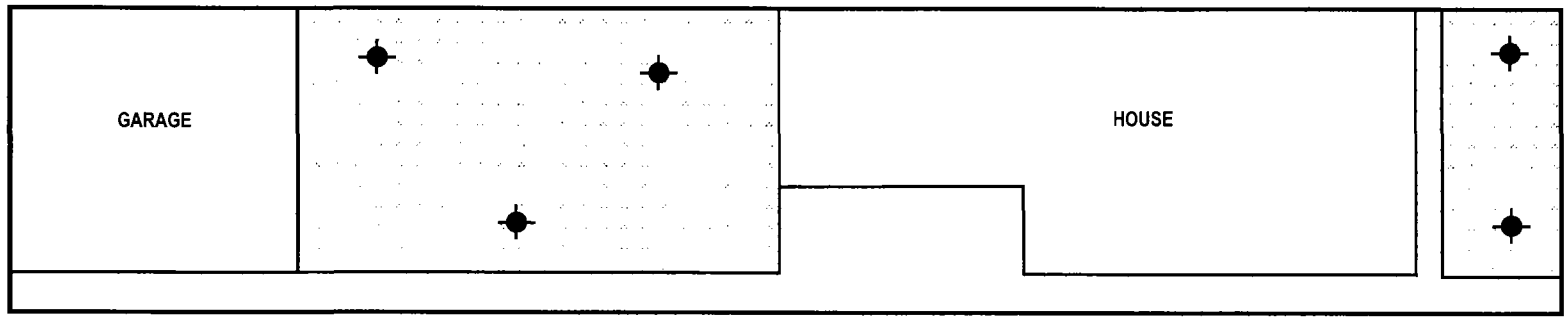
3.8 Data Evaluation

Analytical data will be collected during this investigation in the form of laboratory analytical results. The results will be evaluated through calculation of the B(a)P EQ concentration in accordance with USEPA-approved procedures.

The B(a)P EQ concentration is the sum of the concentrations of seven PAH compounds, after each concentration is multiplied by that compounds relative potency (as compared to benzo(a)pyrene), as shown below:

Compound	Relative Potency
Benzo(a)anthracene	0.1
Benzo(a)pyrene	1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenz(a,h)anthracene	1
Indeno(1,2,3-cd)pyrene	0.1

Compounds that are non-detect will be utilized in the calculation through use of ½ the method detection limit. Estimated values (J qualified) will be used at the reported value.



0 15 30

SCALE: 1" = 15'

LEGEND

- Sidewalk
- Grass
- Typical Soil Boring Locations

Figure 3-1

Schematic Soil Sample Layout for Residential Property
Residential Soil Sampling Work Plan
Former Celotex Site

Chicago, Illinois 60623

Source: Draft Phase III Residential Area Sampling Report, Parsons, June 1999.
Address: 2726 South Spaulding Avenue

SECTION 4

Residential Soil Sampling Report

Following data validation and evaluation, a Residential Sampling Report will be prepared and submitted to USEPA. A proposed outline of the Residential Soil Sampling Report is presented below.

Residential Soil Sampling Report Outline

Executive Summary

1. Introduction
   - 1.1 Purpose of Report
   - 1.2 Site Background
     - 1.2.1 Site Description
     - 1.2.2 Site History
     - 1.2.3 Previous Investigations
     - 1.2.4 Physical Characteristics of Study Area
   - 1.3 Report Organization

2. Field Activities
   - 2.1 Property Descriptions
   - 2.2 Decontamination of Sampling Equipment
   - 2.3 Soil Sampling

3. Results of Residential Soil Sampling
   - 3.1 Sample Data Results
   - 3.2 Data Validation
   - 3.3 Data Evaluation

4. Conclusions and Recommendations

5. References

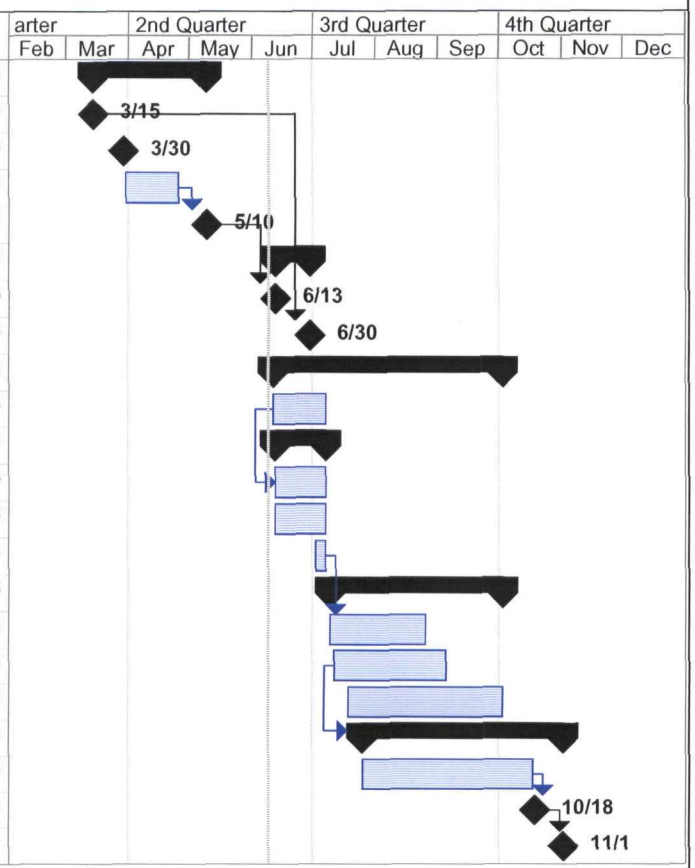
SECTION 5

Project Schedule

Figure 5-1 presents the proposed project schedule for the residential soil sampling.

Figure 5-1
Proposed Project Schedule
Residential Soil Sampling Work Plan
Former Celotex Site
Chicago, Illinois

ID	Task Name	Duration	Start	Finish
1	**Draft Residential Soil Sampling Work Plan**	**40 days**	**Wed 3/15/06**	**Wed 5/10/06**
2	Submit Draft Work Plan to USEPA	0 days	Wed 3/15/06	Wed 3/15/06
3	Receive USEPA Comments	0 days	Thu 3/30/06	Thu 3/30/06
4	Revise Work Plan for Community Distribution	18 days	Fri 3/31/06	Tue 4/25/06
5	Receive Community Responses	0 days	Wed 5/10/06	Wed 5/10/06
6	**Final Residential Soil Sampling Work Plan**	**13 days**	**Tue 6/13/06**	**Fri 6/30/06**
7	Submit Final Work Plan to USEPA	0 days	Tue 6/13/06	Tue 6/13/06
8	Obtain USEPA Approval	0 days	Fri 6/30/06	Fri 6/30/06
9	**Implement Residential Sampling Work Plan**	**81 days**	**Mon 6/12/06**	**Mon 10/2/06**
10	Verify Access Agreements	20 days	Mon 6/12/06	Fri 7/7/06
11	**Complete Initial Site Visits (179 Properties)**	**19 days**	**Tue 6/13/06**	**Fri 7/7/06**
12	Document Current Property Conditions	19 days	Tue 6/13/06	Fri 7/7/06
13	Layout Sample Locations	19 days	Tue 6/13/06	Fri 7/7/06
14	Utility Clearance	5 days	Mon 7/3/06	Fri 7/7/06
15	**Sampling and Analysis**	**61 days**	**Mon 7/10/06**	**Mon 10/2/06**
16	Collect Soil Samples (2 field teams)	35 days	Mon 7/10/06	Fri 8/25/06
17	Analyze Soil Samples (1068 composite samples)	39 days	Wed 7/12/06	Mon 9/4/06
18	Data Validation/Evaluation (PAHs)	54 days	Wed 7/19/06	Mon 10/2/06
19	**Prepare Residential Sampling Report**	**71 days**	**Wed 7/26/06**	**Wed 11/1/06**
20	Develop Residential Sampling Report	60 days	Wed 7/26/06	Tue 10/17/06
21	Submit Residential Sampling Report to USEPA	0 days	Wed 10/18/06	Wed 10/18/06
22	Receive USEPA Comments/Approval	0 days	Wed 11/1/06	Wed 11/1/06



Project: Celotex_Schedule_FINAL_060906.mpp
Date: Fri 6/9/06

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

SECTION 6

References

Alceon Corporation, October 25, 1996, Deterministic and Probabilistic Calculations to Estimate Risk-Based Cleanup Goals for Soils at Residences near the 2800 South Sacramento Avenue Site, Chicago, Illinois, as Amended.

Ecology & Environment, October 1995, Streamlined Human Health Risk Evaluation, Celotex Site, Chicago, Illinois.

Environmental Resources Management-North Central, Inc., October 1995, Data Report, Residential Soil Sampling, Celotex Site, Chicago, Illinois.

Illinois State Geological Survey, 1985, Cooperative Groundwater Report 10, Geology, Hydrology and Water Quality of the Cambrian and Ordovician Systems in Illinois.

Illinois State Geological Survey, 1988, Circular 542, Stack-Unit Mapping of Geological Materials.

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Parsons Engineering Science, Inc., August 1998, Draft Phase II Residential Area Sampling Report for the Engineering Evaluation and Cost Analysis of the 2800 South Sacramento Avenue Site.

Parsons Engineering Science, Inc., October 1998, Final Main Site Risk Assessment for the Engineering Evaluation and Cost Analysis of the 2800 South Sacramento Avenue Site.

Parsons Engineering Science, Inc., June 1999, Draft Phase III Residential Area Sampling Report for the Engineering Evaluation and Cost Analysis of the 2800 South Sacramento Avenue Site.

Parsons Engineering Science, Inc., March 2004, Final Engineering Evaluation and Cost Analysis Report of the 2800 South Sacramento Avenue Site.

U.S Department of Agriculture, 1979, Soil Survey of DuPage and Parts of Cook Counties.

U.S Department of the Interior, 1984, Englewood Quadrangle, 7.5-minute series, National Wetlands Inventory Map.

U.S Geological Survey, 1929 and 1963-photo revised 1972, Topographic Map, 7.5 minute series, Englewood Quadrangle.

U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, Method 8270C, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry.

U.S. Environmental Protection Agency, 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final.

U.S. Environmental Protection Agency, 1999, Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.

U.S. Environmental Protection Agency, 1993 Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA.

U.S. Environmental Protection Agency, Lead Sites Workgroup, August 2003, Superfund Lead-Contaminated Residential Sites Handbook.

APPENDIX A

Health and Safety Plan

HEALTH AND SAFETY PLAN

For the
Residential Study Area
near the
Former Celotex Site
2800 South Sacramento Avenue
Chicago, Illinois 60623

Prepared for
Honeywell International Inc.
101 Columbia Road
Morristown, New Jersey 07962

June 2006

Prepared by

CH2MHILL

HEALTH AND SAFETY PLAN
Honeywell – Former Celotex Facility
2800 S. Sacramento Avenue
Chicago, Illinois

		PHONE
Project Number:	327757	
Project Manager:	Joel Wipf/CHI	773-693-3800 x253
Safety Coordinator (SC)TBD		
Honeywell Program H&S Manager (HSM)	Bill Berlett	773-693-3800 x316 847-770-0209 (cell)
Honeywell Remediation Manager	Chuck Geadelmann	763-954-5418
Preparation Date:	March 3, 2006	
Expiration Date:	March 3, 2007	

APPROVALS

Safety Coordinator

_____
(DATE)

Honeywell Program Health and Safety Manager:

_____
CIH/CSP (DATE)

Project Manager:

_____
(DATE)

This Health and Safety Plan is valid only for this specific project as described in Section 1.0. It is not to be used for other projects or subsequent phases of this project without the written approval of the Honeywell Program Health and Safety Manager. **A copy of this plan is to be maintained with the field team at all times.**

INTRODUCTION – SITE BACKGROUND

This Health and Safety Plan (HSP) will be kept with the field team inside field vehicles at all times during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the CH2M HILL *Health, Safety, and Environmental Protection (HS&E) Program Manual*, as appropriate. In addition, this plan adopts procedures in the project Work Plan and incorporates applicable elements of Honeywell's HS&E requirements. The Safety Coordinator (SC) is to be familiar with the SOPs contained in the HS&E Program Manual and the contents of this plan.

CH2M HILL's personnel and subcontractors must sign the CH2M HILL Employee Sign-Off Form included in Attachment 1 after reading/reviewing this HS&E Plan.

SITE BACKGROUND AND DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED

The former Celotex Site was used for making, storing and selling asphalt-roofing products. Former operations at the 24-acre Main Site during the approximate period of 1911 to 1989 resulted in the release of polynuclear aromatic hydrocarbons (PAHs) in the air. It is possible that PAH compounds may have migrated through airborne dispersion beyond the Celotex site boundaries and may be present in surface soils in some residential areas surrounding the Site.

The scope of work covers collection of soil samples from residential areas surrounding the Main Site in accordance with the Residential Soil Sampling Work Plan (CH2M HILL, March 2006). The specific tasks associated with soil sampling and covered by this HSP are summarized as follows.

- Site visits to coordinate access agreements, document existing site conditions, layout sample locations for utility clearance, identify any potential safety considerations, and related activities
- Surface and near subsurface (≤ 3 feet bgs) soil sampling using either a hand auger, portable two-man gasoline powered post hole auger drill, or a portable geoprobe drilling machine.
- Decontamination, field documentation, and related support activities

Emergency Contacts and Hospital Route Map-

24-hour CH2M HILL Emergency Beeper – 720-286-4911

Medical Emergency - 911

Fire/Spill Emergency -- 911

Security & Police - 911

Local Facility Emergency Response Number:

CH2M HILL Medical Consultant
Health Resources
Dr. Jerry H. Berke, M.D., M.P.H.
600 West Cummings Park, Suite 3400
Woburn, MA 01801-6350
1-781-938-4653 (8 am to 11 pm EST)
1-800-350-4511 (after hours and on weekends)
(After hours calls will be returned within 20 minutes)

Honeywell Health, Safety & Environment Manager
Name: Bill Berlett/CHI
Phone: 773-693-3800 x 316
Cell: 847-770-0209
Fax: 773-693-3823

Environmental Compliance Coordinator (ECC)
Name: Linda Hickok/SYR
Phone: (315) 422-7250 x229

Project Health & Safety Manager (HSM)
Name: Bill Berlett/CHI
Phone: 773-693-3800 x 316
Cell: 847-770-0209
Fax: 773-693-3823

Safety Coordinator (SC)
Name: TBD
Phone:

Project Manager (PM)
Name: Joel Wipf/CHI
Phone: 773-693-3800x253
Cell: 773-793-0468

Regional Human Resources Department (Workers' Compensation Contact)
Name: Cindy Bauder/WDC
Phone: 703/471-6405 ext. 4243

Federal Express Dangerous Goods Shipping
Phone: 800/238-5355

CH2M HILL Emergency Number for Shipping Dangerous Goods
Phone: 800/255-3924

Worker's Compensation:
Contact Regional HR dept. to have form completed or contact Albert Jerman after hours: 303-741-5927

Automobile Accidents:
Rental: Carol Dietz/COR 303/713-2757
CH2M HILL owned vehicle:
Zurich Insurance Co. 800-987-3373

Contact the PM. Generally, the PM will contact relevant government agencies.

Facility Alarms: N/A

Evacuation Assembly Area(s): TBD by SC

Facility/Site Evacuation Route(s): TBD by SC

Hospital Name/Address: Mt. Sinai
1501 S. California
Chicago, Illinois
Phone:773-542-2000

Directions to Hospital

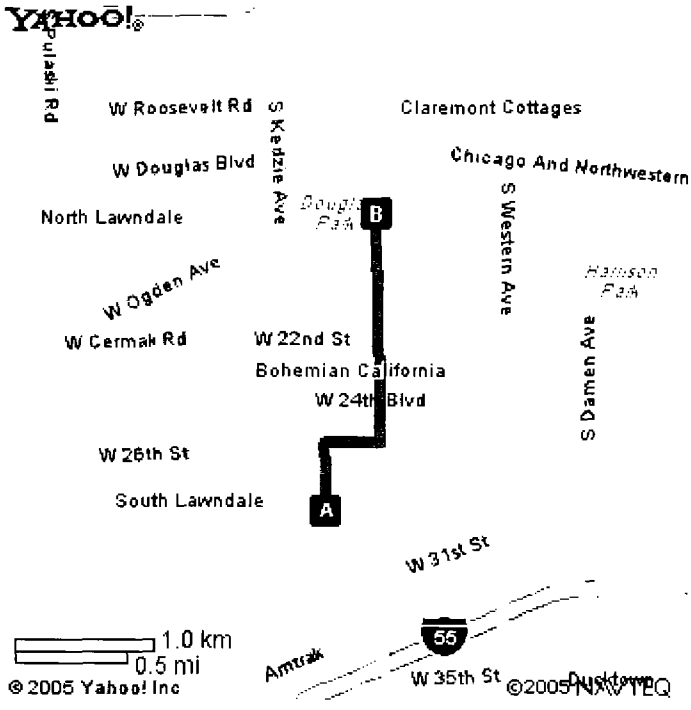
See map on following page

Celotex, Chicago, Illinois

Hospital Route Map and Directions

From the site travel north on Sacramento approximately three blocks to 25th Street. Turn right and travel east on 25th Street approximately 2 blocks to California Avenue. Turn left on California and travel north approximately one mile to the hospital, which will be on the right side of the street.

Please Note: The above directions start at the former Celotex facility address at 2800 S. Sacramento Avenue. The starting direction shall change as the location of exact site changes. Please ensure that all field workers are aware of this change. The map below is given for reference.



Change Management Form

Honeywell Project HS&E Change Management Form

*This evaluation form should be reviewed on a **continuous** basis to determine if the current site health and safety plan adequately addresses ongoing project work, and should be completed whenever new tasks are contemplated or changed conditions are encountered.*

Project Task:	Residential properties soil sampling either by hand auger or power auger from surface to approximately three feet below ground surface.		
Project Number:	**327757**	Project Task Manager:	Joel Wipf
Name:	**Former Celotex Facility – Chicago, Illinois**	Employee #:	16848

	Evaluation Checklist	Yes	No
1.	Have the CH2MHILL staff listed in the original HSP FSI changed?		
2.	Has a new subcontractor been added to the project?		
3.	Is any chemical or product to be used that is not listed in Attachment 2 of the plan?		
4.	Have additional tasks been added to the project, which were not originally addressed in the plan?		
5.	Have new contaminants or higher than anticipated levels of original contaminants been encountered?		
6.	Have other safety, equipment, activity or environmental hazards been encountered that are not addressed in the plan?		

If the answer is "YES" to Question 3, an HSP/FSI revision is NOT needed. Please take the following actions:

- Add the chemical to Attachment 2, and ensure employees handling the chemical are trained, and training documentation is added to Attachment 3.

If the answer is "YES" to Questions 1, 2 or 4-6, an HSP/FSI revision MAY BE NEEDED. Please contact Bill Berlett (773-693-3800 x316) directly.

TABLE OF CONTENTS

1 Tasks to be Performed Under this HS&E Plan

1.1 Description of Tasks

(Reference Field Project Start-up Form)

Refer to project documents (i.e., Work Plan) for detailed task information. A task hazard analysis has been performed for each task and is included below while project-specific hazard controls are provided in the next section. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin. Refer to Hazwoper Compliance Plan Section of this HS&E Plan for procedures related to "clean" tasks that do not involve hazardous waste operations and emergency response (Hazwoper).

1.1.1 Hazwoper-Regulated Tasks

The following tasks are regulated under HAZWOPER:

- Residential soil sampling using either a hand auger, power auger, or portable geoprobe drilling machine

1.1.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. The following tasks are considered non-hazardous.

- Site surveys - may be done simultaneously with the soil sampling activities.

1.1.3 Environmental-Regulated Tasks and Conditions

Project tasks and site conditions that can impact the environment and are otherwise subject to environmental regulation are included in Section 1.3. These items are also known as the environmental aspects of the project (activities that can interact with the environment). Environmental impacts relating to each task or condition are also presented in Section 1.3, which is used to evaluate the project's significant impacts and control measures specified in Hazard Controls and Safe Work Practices section of this HS&E Plan.

All personnel shall: (1) implement control measures described in Hazard Control Section; (2) obtain appropriate environmental training (e.g., Waste Management or Dangerous Goods Shipping) and (3) seek assistance from the regional Environmental Compliance Coordinator (ECC) for all environmental questions or issues.

1.2 Task Hazard Analysis

TASKS	POTENTIAL HAZARDS (Refer to Hazard Control Section for additional information)																											
	Aerial Lifts	Back Injury (Bending Lifting)	Biological Hazards	Buried Utilities	Cold Stress	Confined Space Entry	Electrical	Elevated Work Areas Falls	Entanglement	Excavations	Fires	Flying Debris Objects	Gas Cylinders	Hand and Power Tools	Heat Stress	Heavy Equipment Exposure	Ionizing Radiation	Lockout-Tagout	Noise	Radio-Frequency Radiation	Respirators Protection	Slips, Trips and Falls	Stairways and Ladders	Suspended Loads	Traffic Exposure	Vehicle Backing Exposure	Visible Lightning	Working Above or Near Water
Hand power augering		X	X	X					X			X		X	X				X			X			X			
Portable Geoprobe Machine		X	X	X					X			X		X	X	X			X			X			X			
Property Surveying			X												X							X			X			
Soil Sample Collection		X	X											X	X							X			X			

1.3 Environmental Impacts

(Refer to the Hazard Control Section for control measures)

Tasks/Conditions	Impacts						
	Air Pollution	Land Pollution	Land Disposal	Noise Pollution	Water Pollution	Resource Depletion	Human Hazard
Chemical Petroleum Storage or Transport		X			X		X
Waste (Haz/Non-Haz) Mgmt, Transport and Disposal		X	X		X		X

2 Hazard Controls and Safe Work Practices

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the SC for clarification. In addition to the hazard controls specified in this section, the following are required for Honeywell projects.

HS&E Plans: CH2M HILL requires HS&E plans for all field projects and subcontractors are required to submit a plan for their activities as well. The HS&E plan provides a risk analysis of each task and identifies the potential hazards and control measures (including personal protective equipment and air monitoring requirements) for each task.

Job Hazard Analysis (JHAs): JHAs are required by CH2M HILL for all tasks unless the HSM specifically determines it is unnecessary. JHAs provide a step-by-step analysis of the activity being performed and identifies the equipment and control measures necessary to conduct the work safely. JHAs must be reviewed by the work team immediately prior to conducting the work. The JHAs can be a source of information for the daily safety meeting. Copies of JHAs are provided in Attachment 2.

Safety Meetings: CH2M HILL requires that the safety coordinator conduct daily safety meetings to discuss with the field team the task to be performed that day and the potential hazards and mitigation measure. In addition, the safety meeting can be used to review the JHA with the team.

Self-Assessments: Project Activity Self-Assessment Checklists are contained in Attachment 3. These checklists provide a method of verifying compliance with established safe work practices, regulations, and industry standards pertaining to hazardous activities. The checklists can be used by any CH2M HILL employee who may be exposed to a hazardous activity or by the SC when providing oversight of a subcontractor performing a hazardous activity. Self-assessments shall be completed prior to subjecting CH2M HILL staff to hazardous operations for any reason. Self-assessment checklists should be completed weekly during field work.

If hazardous conditions exist or are apparent during the self-assessment, immediately notify the employees in the area and do not continue work in that area until the conditions are safe. If an imminent danger situation (immediately life threatening or would cause serious injury) exists, immediately stop work, warn all personnel in danger and notify the appropriate safety representative and the CH2M HILL SC. Non-compliance issues identified during the self-assessment shall be immediately rectified. If corrective action assistance is required, the HSM should be contacted for guidance.

Any site-specific requirements outlined in this HS&E Plan that are more stringent than those contained in the self-assessment checklists are to take precedence. The self-assessment checklists are based upon minimum regulatory compliance and some site-specific requirements may be more stringent. The self-assessment checklists, including documented corrective actions, shall be made part of the permanent project records and maintained by the SC.

In addition to conducting self-assessments, audits will be conducted by a HS&E professional as follows: a minimum of one field audit is to be conducted during the field work component of this project.

Interventions: Honeywell requires that we intervene whenever we see someone exhibiting an unsafe behavior or working in unsafe conditions. When such a situation is observed, an intervention is performed by talking to the person about how the task could be done more safely.

2.1 Project-Specific Hazards and Controls

2.1.1 Backing Field Vehicles

The following precautions shall be implemented to prevent incidents during backing of field vehicles:

- Avoid backing whenever possible. The SC will be responsible for determining when "backing" is allowed. If extensive backing is required, alarms that sense when an object is close by must be used.
- If backing is required, there MUST BE a spotter. If a spotter is not available, the driver MUST walk completely around the vehicle before backing up.
- When "backing" is likely to be a part of the activities, it must be discussed in the daily safety briefings to remind staff of the hazards and controls.
- Learn your vehicle's blind spots.

2.1.2 Driving in Areas with Tall Grass/Brush

Driving in areas with tall grass brush can present a potential fire hazard if the grass brush gets caught under and or remains in contact with the vehicle exhaust system. Employees should exercise the following precautions:

- When stopping vehicle, ensure it is in an area where grass is not tall.
- Do not leave vehicle idling once stopped.
- When possible, try to drive through areas where grass is not tall or grass has been beaten down.
- Ensure that a fire extinguisher is available for each vehicle.
- Keep fire extinguisher readily available in passenger area of vehicle while driving.
- Keep fire extinguisher outside of vehicle upon stopping.
- Address fire hazards and controls in daily safety briefings as appropriate.

2.2 General Hazards and Controls

2.2.1 General Practices and Housekeeping

(Reference CH2M HILL SOP HS-209, *General Practices*)

- Site work should be performed during daylight hours whenever possible. Work conducted during hours of darkness require enough illumination intensity to read a newspaper without difficulty.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, and or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and working surfaces.

2.2.2 Hazard Communication

(Reference CH2M HILL SOP HS-107, *Hazard Communication*)

The SC is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using Attachment 4.
- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available.

- Copies of all applicable MSDSs will be placed in Attachment 5.
- Request or confirm locations of Material Safety Data Sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using Attachment 6.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

2.2.3 Shipping and Transportation of Chemical Products

(Reference CH2M HILL's *Procedures for Shipping and Transporting Dangerous Goods*)

Chemicals brought to the site might be defined as hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

2.2.4 Lifting

(Reference CH2M HILL SOP HS-112, *Lifting*)

- Proper lifting techniques must be used when lifting any object.
  - Plan storage and staging to minimize lifting or carrying distances.
  - Split heavy loads into smaller loads.
  - Use mechanical lifting aids whenever possible.
  - Have someone assist with the lift -- especially for heavy or awkward loads.
  - Make sure the path of travel is clear prior to the lift.

2.2.5 Fire Prevention

(Reference CH2M HILL SOP HS-208, *Fire Prevention*)

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet. Extinguishers must:
  - be maintained in a fully charged and operable condition,
  - be visually inspected each month, and
  - undergo a maintenance check each year.
- The area in front of extinguishers must be kept clear.
- Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 feet from any building.
- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Flammable combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

2.2.6 Stairways and Ladders

(Reference CH2M HILL SOP HS-214, *Stairways and Ladders*)

- Stairway or ladder is generally required when a break in elevation of 19 inches or greater exists.
- Personnel should avoid using both hands to carry objects while on stairways; if unavoidable, use extra precautions.
- Personnel must not use pan and skeleton metal stairs until permanent or temporary treads and landings are provided the full width and depth of each step and landing.
- Ladders must be inspected by a competent person for visible defects prior to each day's use. Defective ladders must be tagged and removed from service.

- Ladders must be used only for the purpose for which they were designed and shall not be loaded beyond their rated capacity.
- Only one person at a time shall climb on or work from an individual ladder.
- User must face the ladder when climbing; keep belt buckle between side rails
- Ladders shall not be moved, shifted, or extended while in use.
- User must use both hands to climb; use rope to raise and lower equipment and materials
- Straight and extension ladders must be tied off to prevent displacement
- Ladders that may be displaced by work activities or traffic must be secured or barricaded
- Portable ladders must extend at least 3 feet above landing surface
- Straight and extension ladders must be positioned at such an angle that the ladder base to the wall is one-fourth of the working length of the ladder
- Stepladders are to be used in the fully opened and locked position
- Users are not to stand on the top two steps of a stepladder; nor are users to sit on top or straddle a stepladder
- Fixed ladders ≥ 24 feet in height must be provided with fall protection devices.
- Fall protection should be considered when working from extension, straight, or fixed ladders greater than six feet from lower levels and both hands are needed to perform the work, or when reaching or working outside of the plane of ladder side rails.

2.2.7 Heat Stress

(Reference CH2M HILL SOP HS-211, *Heat and Cold Stress*)

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°F to 60°F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shelter shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SC to avoid progression of heat-related illness.

SYMPTOMS AND TREATMENT OF HEAT STRESS					
	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure, oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool but not cold water. Call ambulance, and get medical attention immediately!

Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (>50 percent), or when workers exhibit symptoms of heat stress.
The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 100 beats/minute at the beginning of the next rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats/minute, or 20 beats/minute above resting pulse.

CH2M HILL has adopted the recommendations on thermal stress developed by the National Safety Council. Additional recommendations are provided by the American Conference of Governmental Industrial Hygienists and are found in the most recent edition of *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*.

2.2.8 Compressed Gas Cylinders

- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.
- Cylinders must be shielded from welding and cutting operations and positioned to avoid being struck or knocked over; contacting electrical circuits; or exposed to extreme heat sources.
- Cylinders must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.

2.3 Biological Hazards and Controls

2.3.1 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake; note color, size, patterns, and markings.

2.3.2 Poison Ivy and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

2.3.3 Ticks

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray **only outside** of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks.

If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite.

In both cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention.

2.3.4 Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SSC and or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

2.3.5 Bloodborne Pathogens

(Reference CH2M HILL SOP HS-202, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and personal protective equipment (PPE) are required as specified in CH2M HILL SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

2.3.6 Mosquito Bites

Due to the recent detection of the West Nile Virus in the Southeastern United States it is recommended that **preventative measures** be taken to reduce the probability of being bitten by mosquitoes whenever possible. Mosquitoes are believed to be the primary source for exposure to the West Nile Virus as well as several other types of encephalitis . The following guidelines should be followed to reduce the risk of these concerns for working in areas where mosquitoes are prevalent.

- Stay indoors at dawn, dusk, and in the early evening.
- Wear long-sleeved shirts and long pants whenever you are outdoors.
- Spray clothing with repellents containing permethrin or DEET since mosquitoes may bite through thin clothing.
- Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35% DEET (N,N-diethyl-meta-toluamide). DEET in high concentrations (greater than 35%) provides no additional protection.
- Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands.
- Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's DIRECTIONS FOR USE, as printed on the product.

Note: Vitamin B and "ultrasonic" devices are NOT effective in preventing mosquito bites.

Symptoms of Exposure to the West Nile Virus

Most infections are mild, and symptoms include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands. More severe infection may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and, rarely, death.

The West Nile Virus incubation period is from 3-15 days.

If you have any questions or to report any suspicious symptoms, contact the project Health and Safety Manager (HSM).

2.3.7 Dog Safety

- In areas known to be frequented by feral dogs, equip each field team with dog repellant (e.g., Shock Dog Repellent or other capsaicin-based spray).

- Read manufactures instructions.
  Position yourself up-wind if possible before using.
  Only use if attacked-- not just threatened.

- Avoid all dogs – both leashed and stray.
- Don't disturb a dog while it is sleeping, eating or caring for puppies.
- If a dog approaches to sniff you - stay still.
- An aggressive dog has a tight mouth, flattened ears and a direct stare.
- If you're threatened by a dog, remain calm – don't scream and avoid eye contact.
- If you say anything, speak calmly and firmly.
- Don't turn and run -- try to stay still until the dog leaves, or back away slowly until the dog is out of sight or you have reached safety (e.g., vehicle).
- If attacked, retreat to vehicle or attempt to place something between you and the dog.
- If you fall or are knocked to the ground, curl into a ball with your hands over your head and neck, and protect your face.
- If bitten, immediately scrub the bite site vigorously with soap and water.
- Report the incident to the local authorities.
- Seek medical attention as soon as possible.

It is recommended that during the survey phase of the field project site personnel inquire with each household if dogs are present and to keep an eye out for stray dogs. If dogs are present in a household or if dogs are observed, note the locations of dogs and inform the sample crews of their whereabouts. Request residents to keep their dogs indoors during field work.

2.4 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
PAHs (Limits as Coal Tar Pitch)	GW:NA SB:NA SS: 50 ppm Benzo(a)pyrene *Equivalents*	0.2 mg m^3	80 mg m^3 CA	Eye, skin and respiratory tract irritation. Prolonged contact with skin may cause dermatitis and hyperpigmentation of skin.	UK

Footnotes:

[a] Actual sample analysis data for the residential area included in this project is not available, therefore there are no data to use. Background data for the Chicagoland area indicates concentrations of PAHs approximately 1.0 mg m^3. Specify sample-designation and media: SB (Soil Boring), SS (Surface Soil), GW (Ground Water).

[b] OSHA PEL or ACGIH TLV lowest value listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); ND = Not determined; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

2.5 Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Personal Protective Equipment (PPE) Section of this plan.

Inhalation: Contaminated particulates. This route of exposure is minimized through proper work controls such as avoid dust generation and or dust suppression such as watering down the area to be augered/drilled prior to commencing with the augering/drilling and through proper respiratory protection and monitoring, as specified in Personal Protective Equipment (PPE) and Air Monitoring/Sampling Sections of this plan, respectively. It is not anticipated that respiratory protection will be needed during this field project.

Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

3 Project Organization and Responsibilities

3.1 Client

Contact Name: Chuck Geadelmann
Phone: 763-954-5418
Facility Contact N A
Phone: N A

3.2 Owner

Contact Name: Residential Owners - TBD
Phone:
Onsite Contact Name:
Phone:

3.2 CH2M HILL Employee Medical Surveillance, Training, & Drug Testing

(Reference CH2M HILL SOPs HSE-113, *Medical Surveillance*, HSE-110, *Training*, HSE-105, *Drug-Free Workplace*)

Employees assigned to this project will have the following minimum training.

- 40-hour hazardous waste operations training
- 3-day on-the-job experience
- 8-hour annual hazardous waste refresher training.
- Employees who are in an on-site supervisor role will complete 8 hours of hazardous waste supervisor training
- Drug-Free Workplace training (when drug testing is required)
  (http: www3.intch2m.com intrnl voffice corp health Training Basic_Modules Drug1.html)
- Honeywell Program orientation
- Site-specific training orientation

Employees designated as Safety Coordinator (SC) have completed a 12-hour safety coordinator course. The safety coordinator training course meets the requirements of 29 CFR 1910.120 for on-site supervisor training. An SC must be present during all tasks performed in exclusion or decontamination zones. The SC and additional designated employees, as necessary, will be certified in first aid and cardiopulmonary resuscitation (FA-CPR) by the American Red Cross, or equivalent. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training. Additional training requirements are addressed in the specific hazard sections of this plan.

Employees who perform work activities in the decontamination or exclusion zone shall be enrolled in and have a current medical clearance as required by the medical surveillance program for hazardous waste workers. Pregnant employees shall consult with the Corporate Consulting Physician prior to performing site activities and obtain a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

All staff who conduct fieldwork for Honeywell must pass a drug and alcohol screen prior to working in the field if they are involved in either the power augering or portable geoprobe drilling machine activities. They must be enrolled in a random testing program for the duration of their work on Honeywell, and will be subject to post-incident and "for cause" testing. Staff who will be conducting only site visits, preliminary home visits or conducting only hand auger soil sampling activities will not be

required to meet Honeywell's Drug and Alcohol Testing Program, and thus, a drug and alcohol screen will not be required prior to working in the field.

Employee Name	Office	Responsibility	SC/FA-CPR
Safety Coordinator - TBD			Level C SC FA-CPR
Field Technician- TBD			Haz Waste Worker

3.3 CH2M HILL Staff Responsibilities

3.3.1 CH2M HILL Project Manager

The CH2M HILL project manager (PM) is responsible for providing adequate resources (budget and staff) for project-specific implementation of the HSE management process. The PM has overall management responsibility for the tasks listed below. The PM may delegate specific tasks to other staff, as described in sections that follow, but retains ultimate responsibility for completion of the following in accordance with this HS&E Plan:

- Incorporate standard terms and conditions, and contract-specific HSE roles and responsibilities in the contract with the client.
- Budget for the appropriate level of HSE oversight during field activities. Contact the HSM for budget requirements and guidelines.
- Manage the site and interface with third parties in a manner consistent with our contract and subcontract agreements and the applicable standard of reasonable care.
- Ensure that the overall, project-specific HS&E goals are fully and continuously implemented.
- Ensure that CH2M HILL's safety coordinator is completing all duties outlined in this HS&E Plan.
- Promoting a safety culture with onsite CH2M HILL personnel and setting the example for safe behavior.

The PM has the following additional responsibilities when subcontractors are hired:

- Incorporate standard terms and conditions, and contract-specific HSE roles and responsibilities in subcontract agreements (including flow-down requirements to lower-tier subcontractors).
- Select safe and competent subcontractors by implementing the CH2M HILL Subcontractor Management Program. This program includes the review of subcontractor pre-qualification questionnaires, training and medical monitoring records, and site-specific safety procedures prior to the start of subcontractor's field operations.
- Ensure that acceptable certificates of insurance, including CH2M HILL as named additional insured, are secured as a condition of subcontract award.
- Maintain copies of subcontracts and subcontractor certificates of insurance, bond, contractors license, training and medical monitoring records, and project-specific HSE procedures in the project file accessible to site personnel.

- Provide adequate oversight of subcontractor HSE practices per the HS&E Plan.

3.3.2 CH2M HILL Health and Safety Manager

The CH2M HILL Health and Safety manager (HSM) is responsible to:

- Support the SC's oversight of HSE practices and interfaces with onsite third parties per the HS&E Plan.
- Conduct audits, as necessary, to assess site conditions and review HSE program implementation.
- Assist the PM with HSE budget guidelines.
- Assist with program implementation as needed.

The HSM has the following additional responsibilities when subcontractors are hired:

- Ensure that subcontractor pre-qualification questionnaires are reviewed and assist as applicable in the acceptance or rejection.
- Review and accept or reject subcontractor training records and site-specific safety procedures prior to start of subcontractor's field operations.
- Support the SC's oversight of subcontractor's (and lower-tier subcontractor's) HS&E practices per the HS&E Plan.

3.3.3 Safety Coordinator

The Safety Coordinator (SC) shall be onsite for the duration of onsite work and is responsible for verifying that the project is conducted in a safe manner including the following obligations:

- Verify that this HS&E Plan is current and amended when project activities or conditions change.
- Verify that CH2M HILL site personnel and subcontractors read this HS&E Plan and sign the CH2M HILL Employee Sign-Off Form included in Attachment 1.
- Verify compliance with the requirements of this HS&E Plan, applicable contractor health and safety plan(s) and any federal, state, and local regulations.
- Review and understand contractual obligations regarding HSE roles and responsibilities.
- Manage the site and interfacing with third parties in a manner consistent with our contract subcontract agreements and the applicable standard of reasonable care.
- Ensure that programs are effectively functioning to prevent and control hazards on the project.
- Verify that all CH2M HILL employees working in the field have the appropriate level of HSE training, medical surveillance, and drug and alcohol testing for their job duties including required specialty training (e.g., fall protection, confined space entry) identified in the Hazard Controls and Safe Work Practices Section of this HS&E Plan.
- Conduct an HSE orientation for all CH2M HILL team members prior to entering the project work areas and deliver field HSE training as needed based on project-specific hazards and activities.
- Maintain active and visible involvement using open communication with employees regarding safety issues on the project.
- Verify that safety meetings are conducted and document in the project file as needed throughout the course of the project (e.g., as tasks or hazards change).

- Attend Contractor safety meetings and ask questions about access to work areas, safety hazards, precautions and other general safety issues.
- Post required information onsite. The OSHA job-site poster is required at sites where project field offices, trailers, or equipment-storage boxes are established. Contact the HSM for posters.
- Maintain HSE records and documentation.
- Act as the project "Hazard Communication Coordinator" and perform the responsibilities outlined in the Hazard Communication section of this HS&E Plan.
- Act as the project "Emergency Response Coordinator" and perform the responsibilities outlined in the Emergency Preparedness section of this HS&E Plan.
- Verify that project HSE forms, permits and self-assessment checklists are being used as outlined in this plan.
- Ensure that the Drug Testing Hospital Kit is available onsite in the event of a serious injury involving hospital, ambulance, or paramedic care. The hospital kit must accompany the injured employee to the hospital so they will get drug tested. For additional information on the Drug Testing Hospital Kits, refer to Attachment 10.
- Verify appropriate personal protective equipment (PPE) use, availability, and training.
- Inform the HSM of any project incident, ensure that an Incident Report Form (IRF) is completed and conduct incident investigations as outlined in the Incident Reporting and Investigation section of this HS&E Plan.
- Facilitate Occupational Safety and Health Administration (OSHA) or other government agency inspections including accompanying inspector and providing all necessary documentation and follow-up.
- Report all incidents to your HS&E Project Manager and Bill Berlett (773-693-3800 x316) immediately. Depending on the type and severity of incident, we may have to report it to Honeywell within hours of occurrence. Bill Berlett will determine what needs to be reported, the timing of the reporting, and coordinate client notification so local and Corporate Honeywell personnel are appropriately notified.

The SC has the following additional responsibilities when subcontractors are hired:

- Verify that project files available to site personnel include copies of executed contracts and certificates of insurance; bond; contractors license; training, medical monitoring, and drug and alcohol testing records; and project-specific HSE procedures prior to start of subcontractor's field operations.
- Verify that ongoing training, medical monitoring, and drug and alcohol testing requirements are being met (e.g., 8-hour refresher, random drug testing programs, etc).
- Perform oversight and or assessments of subcontractor HS&E practices per this HES plan and verify that project activity self-assessment checklists, found in Attachment 3.

3.3.4 CH2M HILL Employees

All personnel are assigned responsibility for safe and healthy operations. This concept is the foundation for involving all employees in identifying hazards and providing solutions. For any operation, individuals have full authority to stop work and initiate immediate corrective action or control. In addition, each worker has a right and responsibility to report unsafe conditions practices. This right represents a significant facet of worker empowerment and program ownership. Through shared values and a belief that all accidents are preventable, our employees accept personal responsibility for working safely. Each employee is responsible for the following:

- Perform work in a safe manner without injury, illness or property damage.
- Perform work in accordance with company policies, and report near misses, injuries, illnesses, and unsafe conditions.

- Report all incidents, include near misses, immediately to supervisor, and file proper forms with a human resources representative. Contact the HSM to ensure client reporting procedures are met. It is important to do incident notification immediately because, depending on the type of incident, we may be required to report to Honeywell within hours of the event.
- Report all hazardous conditions and or hazardous activities immediately to a supervisor for corrective action.
- Intervene when an unsafe behavior and or condition is observed.
- Complete an HSE orientation prior to being authorized to enter the project work areas.
- Inspect assigned PPE to ensure the absence of defects and proper function

3.4 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HSE-215, *Contracts, Subcontracts, and HSE Management Practices*)

Subcontractor: **Not anticipated**
Subcontractor Safety Representative:
Subcontractor's onsite activities:

Subcontractors are not anticipated to be involved in field activities. If site conditions change and a subcontractor is needed, the following will apply.

The subcontractors listed above are covered by this HS&E Plan and must be provided a copy of this document. However, this plan does not address hazards associated with the tasks and equipment that the subcontractor has expertise in (e.g., drilling, excavation work, electrical). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work. Subcontractors must comply with all established health and safety plan(s) for this project. The CH2M HILL SC should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established HS&E Plan(s). CH2M HILL's oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CH2M HILL team members should continuously endeavor to observe subcontractors' safety performance. This endeavor should be reasonable, and include observation of hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. In addition to this level of observation, the SC is responsible for confirming CH2M HILL subcontractor performance against both the subcontractor's task specific safety procedures and applicable self-assessment checklists. Self-assessment checklists, provided in Attachment 3.

HSE related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the CH2M HILL HS&E Plan Employee Sign-Off Form, included in Attachment 1.
- Request subcontractor(s) to brief project team on the hazards and precautions related to their work.
- When apparent, non-compliance unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat non-compliance unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected personnel, notify subcontractor safety representative, stop affected work until adequate corrective measures are implemented, and notify the Project Manager, HSM, and SC as appropriate
- Document all verbal HSE related communications in project field logbook, daily reports, or other records.

Subcontractors are responsible to:

- Comply with all local, state, and federal HSE standards; and project owner HSE requirements.
- Provide a qualified subcontractor safety representative (SSR) to oversee the subcontractor activities and conduct safety inspections for their work.
- Conduct site-specific orientations for *all* subcontractor employees.
- Actively participate in the project HSE program and attend all required safety meetings.
- Meet training, medical monitoring, and drug and alcohol testing requirements for their staff.
- Intervene when they observe unsafe behaviors and or conditions.
- Maintain equipment and supplies necessary to complete activities in a safe manner.
- Notify the CH2M HILL SC of any injury or incident, including near-misses, immediately and submit reports to CH2M HILL within 24 hours. Additionally, all incidents must be reported to the HSM immediately so we can meet Honeywell's incident reporting requirements.

3.5 3rd Parties

(Reference CH2M HILL SOP HSE-215, *Contracts, Subcontracts, and HSE Management Practices*)

3rd Party's Name: **Not anticipated**
Safety Representative:
Onsite Activities:

It is not anticipated that third parties will be involved for this field work. This HS&E Plan does not cover parties who do not have a contractual relationship with CH2M HILL. CH2M HILL is not responsible for the health and safety or means and methods of the contractor's work, and we must never assume such responsibility through our actions (e.g., advising on H&S issues). In addition to this plan, CH2M HILL staff should review 3rd parties' safety plans so that we remain aware of appropriate precautions that apply to us. Except in unusual situations when conducted by the HSM, CH2M HILL must never comment on or approve a 3rd party's safety procedures. Self-assessment checklists, provided in Attachment 3, are to be used by the SC to review the 3rd party's performance ONLY as it pertains to evaluating CH2M HILL employee and subcontractor exposure and safety.

HSE related communications with 3rd parties should be conducted as follows:

- Request the 3rd party to brief CH2M HILL employees and subcontractors on the precautions related to the contractor's work.
- When an apparent 3rd party's non-compliance unsafe condition or practice poses a risk to CH2M HILL employees or subcontractors:
  - Notify the 3rd party's safety representative
  - Request that the 3rd party determine and implement corrective actions

  If needed, stop affected CH2M HILL work until the 3rd party corrects the condition or practice. Notify the client, Project Manager, and HSM as appropriate.
- If apparent 3rd party's non-compliance unsafe conditions or practices are observed, inform the 3rd party's safety representative. CH2M HILL's obligation is limited strictly to informing the 3rd party of the observation – the 3rd party is solely responsible for determining and implementing necessary controls and corrective actions.
- If an apparent imminent danger is observed, immediately warn the 3rd party's employee(s) in danger and notify the 3rd party's safety representative. CH2M HILL's obligation is limited strictly to immediately warning the affected individual(s) and informing the 3rd party of our observation – the 3rd party is solely responsible for determining and implementing necessary controls and corrective actions.
- Document all verbal HSE related communications in project field logbook, daily reports, or other records.

4 Personal Protective Equipment (PPE)

(Reference CH2M HILL SOP HSE-117, *Personal Protective Equipment*, HSE-121, *Respiratory Protection*)

The PPE hazard assessment performed by the HSM requires the following PPE for use during site activities. The PPE required by the table will be evaluated periodically, by the SC, to ensure the adequacy based on air monitoring results or changes to expected site conditions. The SC shall coordinate all changes with the HSM.

4.1 PPE Specifications [a]

Task	Level	Body	Head	Respirator [b]
Hand augering	D	Work clothes; steel-toe, leather work boots; leather work gloves; traffic vest if adjacent to roadway.	Hardhat [c] Safety glasses	None anticipated
Power augering portable direct push drilling	D	Work clothes; steel-toe, leather work boots; leather work gloves; traffic vest if adjacent to roadway	Hardhat [c] Safety glasses Ear protection [d]	None anticipated
Property surveying	D	Work clothes, leather work shoe	Sunglasses as needed	None required
Soil sample collection	D Modified [e]	Work clothes, coveralls [f] Boots: Leather work boots, may upgrade to include outer rubber boot covers based on site conditions Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Ear protection, as warranted [d]	None anticipated
Tasks requiring upgrade None anticipated, but could be any of the above based on actual site conditions	C	Work clothes or cotton coveralls Boots: Steel-toe leather boots OR steel-toe, leather work boots with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, with P100 cartridges.

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.

[b] No facial hair that would interfere with respirator fit is permitted.

[c] Hardhat and splash-shield areas are to be determined by the SC.

[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.

[e] Cartridge change-out schedule will be established by the HSM and at a minimum shall be at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)--then at least every 4 hours. If encountered conditions are different than those anticipated in this HS&E Plan, contact the HSM.

[f] Type of coveralls to be determined by the SC based on actual site conditions.

4.2 Reasons for Upgrading or Downgrading Level of Protection

Upgrade[1]	Downgrade
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels (Section 5) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases the hazard. • Change in work task that will reduce contact with hazardous materials.

[1] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SC qualified at that level is present.

5 Air Monitoring/Sampling

(Reference CH2M HILL SOP HSE-207, *Exposure Assessment for Airborne Chemical Hazards*)

Air monitoring and sampling must be performed to verify that our employees are not be exposed to harmful levels of airborne contaminants and that airborne contaminants are not migrating into public areas. A dust monitor will be used periodically if area and or local airborne dust levels cannot be controlled when conditions such as high wind or high traffic volume exist within the working area. Local dust suppression can be controlled by dousing the boring area with water or water spray. The use of a PID will be used initially to ensure levels of volatile organic compounds within the residential property areas are safe. PID usage after the initial determination period will be at the SC discretion based on site conditions. The initial determination period will be at the discretion of the HSM and will be based on actual site conditions and results of previous air monitoring data.

5.1 Air Monitoring Specifications

Instrument	Tasks	Action Levels[a]	PPE	Frequency [b]	Calibration
Photoionization Detector: OVM with 10.6eV lamp or equivalent	All	ND-1 ppm 1-10 ppm If readings exceed 1 ppm, benzene monitoring shall commence	Level D Level C	Initially and periodically during task	Daily
Colorimetric Tube: Drager or equivalent benzene specific 0.5 c (0.5 to 10 ppm range) with pre-tube, or equivalent	All	<0.5 ppm 0.5-1 ppm >1 ppm	Level D Level C Level B	Initially and periodically when PID > 1 ppm	Not applicable
Dust Monitor: Miniram model PDM-3 or equivalent	All	0 -3 mg m^3 > 3 mg m^3	Level D Level C	Initially and periodically during tasks	Zero Daily
Nose-Level Monitor [c]:	All	< 85 dB(A) 85-120 dB(A) 120 dB(A)	No action required Hearing protection required Stop; re-evaluate	Initially and periodically during task	Daily

[a] Action levels apply to sustained (3 minutes or longer) breathing-zone measurements above background

[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place location where measurement is taken (e.g., "Breathing Zone MW-3," "at surface SB-2," etc.).

[c] Noise monitoring shall be used at the discretion of the SC.

Action levels are based on industrial hygiene principles and practical field experience.

5.2 Calibration

Instruments will be function tested in accordance with the respective manufacturer's instructions for proper instrument use and maintenance. The instrument vendor or the CH2M HILL warehouse staff will ensure equipment has been calibrated in accordance with manufacturer's specifications.

All direct reading instruments will be function tested daily by the SC using span gas, prior to performing work activities and after the completion of the daily activities.

5.3 Air Sampling

It is not anticipated that air sampling will be required during this project. If site conditions change, the following applies.

Air Sampling, in addition to real-time monitoring, may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, beryllium, hexavalent chromium, benzene, methylene chloride, vinyl chloride and certain volatile organic compounds. Air sampling methods will be NIOSH or OSHA certified and samples analyzed by a laboratory that is accredited by the American Industrial Hygiene Association (AIHA) for the compound specific method.

The HSM will develop and specify a sampling approach that includes the number and frequency of sampling events. This approach will be included in this section. The HSM shall interpret all air sampling results and modify the requirements of this HS&E Plan, based on the interpretation. Written notification of air sampling results will be provided to the CH2M HILL site employees and maintained in their HSE records.

Air sampling calibration, documentation, and chain-of-custody will be documented on forms included in Attachment 9, as applicable.

6 Decontamination

(Reference CH2M HILL SOP HSE-506, *Decontamination*)

The SC must establish and monitor the decontamination procedures and their effectiveness based on site conditions using the applicable methods below. Decontamination procedures found to be ineffective will be modified by the SC. The SC must ensure that procedures are established for disposing of materials generated on the site.

6.1 Decontamination Specifications

At a minimum the following procedures will be performed. A decontamination zone will be established adjacent to the exclusion zone in the residential grassy area near the street. After each sample boring location is completed, all non-disposal equipment (field instruments, non-porous sample equipment) will be decontaminated prior to mobilizing to the next location. All disposable materials (i.e., inner outer gloves, porous sample equipment) shall be discarded in appropriate collection containers. Personnel decontamination procedures will include removal of any soil dust from clothing boots and removal of the outer inner disposable gloves. The SC shall continuously monitor these procedures and make changes as necessary.

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SC should establish areas for eating, drinking, and smoking.

The SC shall use the following as applicable.

Personnel

- Outer-glove removal
- Inner-glove removal
- Dispose of PPE in municipal trash, or contain for disposal
- Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal

Sample Equipment

- Wash rinse equipment
- Solvent-rinse equipment
- Contain solvent waste for offsite disposal

6.2 Collection and Disposal of Decontamination Wastes

Waste may be classified as non-investigative waste or investigative field-generated waste. Non-investigative waste, such as litter and household garbage, will be collected on an as-needed basis to maintain each property in a clean and orderly manner. This waste will be containerized and transported to a designated collection bin.

Investigative field-generated waste (in this case decontamination water) will be containerized in U.S. Department of Transportation (DOT)-approved steel 55-gallon drums or other approved containers and stored at an approved designated location. Each container will be properly labeled with site identification and matrix (decontamination fluids and associated solids). A record of each drum used during the investigation should be logged into the daily log book.

Properties should be kept tidy during sampling activities and, when practical upon departure, left with less trash than was present before initiation of sampling.

7.0 Spill Containment and Notification

SPCC-Regulated Project or Facility – If the client facility is subject to a Spill Prevention, Control and Countermeasures (SPCC) Plan, a copy must be obtained and all spill prevention and response must conform to client SPCC requirements. If the client does not have an SPCC Plan and the project requires storage of more than 1,320 gallons of petroleum in 55-gallon containers or greater, a project-specific SPCC plan will be prepared.

Non-SPCC Project or Facility – Projects not subject to SPCC requirements, or storing other hazardous materials shall comply with this section. All onsite personnel shall be trained to follow the procedures described in this section.

Hydraulic pressure is utilized during the use of portable direct push drilling. Spill absorbent material shall be readily available for use should a hydraulic line break and or leak. If this condition arises site personnel shall immediately initiate the procedures described below.

- **Equipment** – Obtain client prior approval for use of client-owned spill containment equipment. If client equipment is not available, the table below provides typical spill equipment that shall be available in the project's support zone. Consult the regional ECC and MSDS for more information.

Minimum Spill Kit Equipment List

Spill Kit
Absorbent material (kitty litter or vermiculite)
Neutralizers (for chemical spills)
– Sodium Carbonate (acid spills)
Citric Acid (base spills)
Absorbent socks and pads
Safety Goggles
Protective Gloves
Tyvek Suit
Waste Containers and Labels

- **Emergency Spill Event** – The release of an unknown hazardous material is considered an emergency spill event. Implement the following procedures during an emergency spill event:

1. Evacuate the area and go upwind
2. Warn others and direct them upwind
3. Immediately contact the onsite Safety Coordinator who will contact the HSM for direction

- **Non-Emergency Spill Event** – A non-emergency spill event includes incidental releases that do not pose a significant safety or health hazard where chemical hazards are known and CH2M HILL personnel can safely implement the following procedures as a first responder:

1. Stop the source of the spill
2. Contain the spill material. If there is a chance the spill will reach nearby drains or waterways, block them off to keep the spill away
3. Contact the onsite Safety Coordinator

- **Cleanup** – Clean up the spilled material wearing the proper PPE identified in the HS&E Plan equipment table if the spilled material is less than 5 gallons and hazards are known. Spills larger than 5 gallons must be cleaned up by a qualified subcontractor since CH2M HILL personnel are not trained to implement OSHA spill response requirements. Dispose of spill debris according to the Waste Management Plan or as directed by the ECC.

    - **Notification and Reporting** – All spills are considered an "incident" and shall be reported internally according to procedures in HSE-111 (Incident Reporting and Investigation SOP). Since many spills may

require agency reporting within 24 hours, it is very important that internal notification occur immediately. The following summarizes required actions:

1. ***Immediately*** notify the onsite Safety Coordinator
2. SC notifies the HSM
3. HSM notifies the Project Manager, who notifies the client
4. HSM notifies the Legal Department of a serious incident
5. HSM, ECC, and client shall determine if the incident is reportable to an agency

8.0 Site-Control Procedures

(Reference CH2M HILL SOP HSE-510, *Site Control*)

- The SC will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety include general discussion of Health and Safety Plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SC will record attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location if CH2M HILL occupies an onsite field trailer or office. Postings must be in accordance with CH2M HILL SOP HSE-116, *OSHA Postings*.
- Establish support, decontamination, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone. For this project a reasonable perimeter surrounding each sample boring location shall be identified as the exclusion zone by the SC prior to beginning work activities. This may include the entire residential yard area or a radius of approximately 25 feet surrounding the sample boring location. The decontamination zone will be identified adjacent to the exclusion zone in the residential grassy area near the street where the field vehicle is parked. All decontamination procedures shall be performed in this zone prior to entry into the support zone. The support zone shall essentially consist of the field vehicle.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- Initial air monitoring is conducted by the SC in appropriate level of protection.
- The SC is to conduct periodic inspections of work practices to determine the effectiveness of this plan – refer to Sections 2 and 3. Deficiencies are to be noted, reported to the HSM, and corrected.

9.0 Hazwoper Compliance Plan

(Reference CH2M HILL SOP HSE-220, *Site-Specific Written Safety Plans*)

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks (Section 1.1.1) might occur consecutively or concurrently with respect to non-Hazwoper tasks. This section outlines procedures to be followed when approved activities specified in Section 1.1.2 do not require 24- or 40-hour training. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site, or while non-Hazwoper-trained staff are working in proximity to Hazwoper activities. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data. Refer to subsections 2.5 and 5.3 for contaminant data and air sampling requirements, respectively.

- When non-Hazwoper-trained personnel are at risk of exposure, the SC must post the exclusion zone and inform non-Hazwoper-trained personnel of the:

  - Nature of the existing contamination and its locations
  - Limitations of their access
  - Emergency action plan for the site

- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.

- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.

10 Incident Reporting and Investigation

(Reference CH2M HILL SOP HSE-111, *Incident Reporting and Investigation*)

10.1 Definitions

10.1.1 Incident

An incident is an undesired event that results or could have resulted in an injury, illness, damage to assets or environment harm. The following events shall be considered incidents:

- Injury or illness to a CH2M HILL employee or CH2M HILL subcontractor employee
- Injury or illness to a third party that was caused by a CH2M HILL activity
- Hazardous substance exposure
- Damage to property or equipment
- Motor vehicle accident
- Fire or explosion
- Spill or release
- Environmental issue permit violation
- A "near-miss"

10.1.2 Near-Miss

A near-miss occurs when an intervening factor prevented an injury, damage to property, or environmental harm from occurring. Examples of near-miss situations include: a hard hat or other personal protective equipment (PPE) prevented an injury; secondary containment or emergency shutoff prevented a spill; or an alert co-worker prevented an accident. All near misses should be reported to the HSM as soon as possible, no later than 24 hours of occurrence.

10.1.3 Serious Incidents

The HSM and Legal and Insurance Department (LID) shall determine if an event should be considered as a serious incident after reviewing the initial incident facts. The general criteria for serious incidents include:

- Intervention by external emergency response organizations
- Hospitalization
- Spills and releases of hazardous substances exceeding the reportable quantity (RQ)
- Potential violations of law or regulation
- Estimated property damage in excess of $10,000

10.2 Incident Notification and Communication

All CH2M HILL and subcontractors' employees shall immediately report any incident in which they are involved to the SC. The SC shall then notify the PM and the HSM immediately thereafter. Immediate reporting is critical because there are certain types of incidents that must be reported to Honeywell within hours of occurrence. The HSM will help the team determine what needs to be reported to Honeywell, how quickly it needs to be reported to Honeywell, and who at Honeywell (local, corporate, etc) needs to be notified, etc.

Incident communications regarding serious incidents (regardless of the party involved) shall be considered sensitive in nature and must be controlled in a confidential manner. Internal communications regarding a serious incident may be conducted with affected project, regional, and Business Group staff but must be kept to a minimum. Communication should be oral whenever possible. If e-mail communications are necessary they shall be sent as confidential emails following the procedure provided in section 6.2.2 of the *Incident Reporting and Investigation* SOP (HSE-111). A LID representative shall direct all internal and external communications, including internal incident reporting, agency reporting, client notification, and incident investigations.

10.3 Incident Reporting

The PM and or the HSM shall ensure that the incident is entered into Honeywell's event tracking system and a CH2M HILL Incident Report Form (IRF) is completed within 24 hours of any incident. CH2M HILL's requirements can be met by entering an electronic IRF directly into the IRF database. The electronic IRF is found on the CH2M HILL HSE web page under Tools and Forms -Electronic Tools and Forms. If unable to submit an IRF electronically, the SC shall complete the hardcopy IRF provided in Attachment 7 and fax the IRF to the human resources representative (for CH2M HILL employee injuries) or the HSM (for all other incidents) for database entry. **An IRF for a serious incident shall not be initiated until directed by a representative of the LID.**

When additional or updated information becomes available that was not included in the original IRF the SC shall forward such information to the human resources representative (for CH2M HILL employee injuries) or the HSM (for all other incidents) so that the IRF may be updated. CH2M HILL staff shall comply with all applicable statutory incident reporting requirements such as those required by Federal agencies (EPA, OSHA, etc.) and local authorities (police).

10.4 Incident Investigation

Incident investigations are to be initiated and completed as soon as possible, but no later than 72 hours after the incident has occurred. The level and type of investigation will be determined by Honeywell and the HSM. **All serious incidents shall be investigated as directed by a representative of the LID.** The HSM may conduct the investigation directly or may delegate this function to the SC or other party, depending on the extent of the incident and staff availability.

When it is determined that the investigation will be lead by the SC, the Incident Investigation Guideline provided in Attachment 7 shall be followed. Typically, minor incident investigations will be completed by the HSM ECC by

including the investigation facts in the IRF. The HSM ECC may require completion of a separate investigation report or the Root Cause Analysis Form for more extensive investigations. The HSM ECC shall ensure that the PM and SC are made aware of investigation findings and all corrective actions, and shall verify that corrective actions are implemented to prevent further incidents.

10.5 Corrective Actions

All corrective actions recommended from the incident investigation report shall be taken to prevent recurrence of the incident. The PM or SC should hold a review meeting to discuss the incident and the corrective actions. The responsible supervisors shall be assigned to carry out the corrective actions and shall inform the SC upon successful implementation of all corrective actions.

11 Emergency Preparedness

(Reference CH2M HILL SOP HSE-106, *Emergency Planning*)

An emergency may be an injury to a worker, an explosion, evacuation, fire, or chemical release. Employees must know what to do if an emergency occurs. This requires pre-planning and communication of these plans to employees.

11.1 Pre-Emergency Planning

The SC shall perform the following pre-emergency planning tasks before starting field activities and coordinate emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate.

- Coordinate with property owner and or review the facility emergency and contingency plans where applicable. Have a copy readily available at the site for review and attach a copy to this HS&E Plan .
- Complete and post the Emergency Contacts form provided in Attachment 8. The SC should confirm that all information provided on the Emergency Contacts form is accurate and appropriately updated.
- Confirm and post evacuation routes, assembly areas and route to hospital.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn)
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone)
- Communicate emergency procedures to all field staff prior to field activities.
- Post "Exit" signs above exit doors and post "Fire Extinguisher" signs above locations of extinguishers in field trailers.
- Keep areas near exits and extinguishers free of obstructions.
- Designate one vehicle as the emergency vehicle, place hospital directions and map inside, and keep keys in ignition during field activities
- Where appropriate and acceptable to the client, inform emergency room and external emergency response organizations of anticipated types of site emergencies.
- Rehearse the emergency response plan before site activities begin, including driving the route to the hospital.
- Emergency drills should be performed periodically, but at least once per year. Upon completion of each drill, the SC shall evaluate the effectiveness of the emergency plan. Any problems or concerns identified during the evaluation must be corrected immediately.

- **Inclement Weather**
  - Work may proceed in light rain- wear rain gear.
  - Exposure to slips, trips and falls is increased during rainy conditions.
  - Take cover in field vehicle during adverse weather conditions (High winds, heavy rain).
  - Work shall cease and cover sought in the event of lightning or tornado warnings.
  - Identify "Take Shelter" areas before starting project.
  - Notify the Project Manager after shelter has been sought.
  - All field vehicles shall have a NOAA Weather Radio with severe weather alert mode on at all times.
  - SC shall be cognizant of the current weather forecast and be prepared to take action in the event of inclement weather at all times.

11.2 Emergency Equipment and Supplies

The SC shall verify that appropriate emergency equipment and supplies are available, as needed, and in proper working order and mark the locations of the equipment on the site map when a map is provided. The following equipment and supplies are typically required:

- Fire Extinguishers
- First aid kit
- Bloodborne pathogen kit
- Personal eye wash station
- Potable water

11.3 Incident Response

The following actions shall be taken in the event of a fire, explosion, or chemical release:

- Shut down CH2M HILL operations and evacuate the immediate area
- Notify appropriate response personnel
- Account for personnel at the designated assembly area(s)
- Assess the need for site evacuation, and evacuate the site as warranted

11.4 Evacuation Procedures

Typical evacuation procedures include the following:

- Evacuation routes and assembly areas will be designated by the SC before work begins
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation
- The SC and a "buddy" will remain on the site after the site has been evacuated (if safe) to inform local responders of the nature and location of the incident
- The SC will account for all personnel at the assembly area
- The SC will write up a report as soon as possible after the emergency the following the guidelines provided in the Incident Report Section of the HS&E Plan.

11.5 Emergency Medical Treatment

The following actions shall be taken in the event of a medical emergency:

- Get medical attention immediately.
- Notify appropriate emergency response authorities listed on the Emergency Contacts form, as necessary.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Make certain that the injured person is accompanied to the emergency room.

The SC will assume control during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room. If the injured is a CH2M HILL employee, the SC or PM must accompany the injured CH2M HILL employee to the emergency room and to any follow-up appointments until the injured is released to full duty.

If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant. When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.

The SC shall ensure that all injuries are reported according to the guidelines in the Incident Reporting and Investigation Section of this HS&E Plan.

12 Recordkeeping

(Reference CH2M HILL SOP HSE-15, *Recordkeeping*)

The following records shall be maintained as indicated. Refer to HSE-15 for complete recordkeeping requirements.

Record	Location	Duration
Medical and Exposure Records	Medical & Training Administrator	Employment + 30 years
HS&E Plans	Project File: MTA	Project duration + 5 years
HS&E Training Records	Project File: HandS Database	Employment + 30 years
Environmental Documentation (permits, approvals, manifests)	Project File: HS&E Archive	Project duration + 5 years

13 Attachments

Attachment 1:	**Employee Signoff Form – Field Safety Instructions**
Attachment 2:	**Job Hazard Analysis**
Attachment 3:	**Project Activity Self-Assessment Checklists**
Attachment 4:	**Project-Specific Chemical Product Hazard Communication Form**
Attachment 5:	**Applicable Material Safety Data Sheets**
Attachment 6:	**Chemical-Specific Training Form**
Attachment 7:	**Incident Report Form and Root Cause Investigation Information**
Attachment 8:	**Emergency Contacts**
Attachment 9:	**Project H&S Forms/Permits**
Attachment 10:	**Drug Testing Hospital Kit Notice**

Attachment 1:

Employee Signoff Form – Field Safety Instructions

CH2MHILL - **Attachment 1**

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: Former Celotex Facility; Chicago, Illinois **Project Number:** 327757

EMPLOYEE NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE

Attachment 2:

Job Hazard Analysis

CH2MHILL

Job Hazard Analysis

Activity:	**Date:**
	Project:
Description of the work:	**Site Supervisor:**
	Site Safety Officer:
	Review for latest use: Before the job is performed.

Work Activity Sequence (Identify the principal steps involved and the sequence of work activities)	**Potential Health and Safety Hazards** (Analyze each principal step for potential hazards)	**Hazard Controls** (Develop specific controls for each potential hazard)

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Job Hazard Analysis

Equipment to be used (List equipment to be used in the work activity)	**Inspection Requirements** (List inspection requirements for the work activity)	**Training Requirements** (List training requirements including hazard communication)

CH2MHILL

Job Hazard Analysis

	PRINT NAME	SIGNATURE	
Supervisor Name:	_____	_____	Date/Time: _____
Safety Officer Name:	_____	_____	Date/Time: _____
Employee Name(s):	_____	_____	Date/Time: _____
	_____	_____	Date/Time: _____
	_____	_____	Date/Time: _____
	_____	_____	Date/Time: _____
	_____	_____	Date/Time: _____
	_____	_____	Date/Time: _____
	_____	_____	Date/Time: _____
	_____	_____	Date/Time: _____
	_____	_____	Date/Time: _____

Attachment 3:

Project Activity Self-Assessment Checklists

CH2M HILL

HS&E Self-Assessment Checklist - DRILLING

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's written safety plan.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to drilling hazards, 2) CH2M HILL staff are providing support function related to drilling activities, and or 3) CH2M HILL oversight of a drilling subcontractor is required.

Safety Coordinator may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately, or all exposed personnel shall be removed from the hazard until corrected.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards (complete Section 1).
☐ Evaluate CH2M HILL support functions related to drilling activities (complete Section 2)
☐ Evaluate a CH2M HILL subcontractor's compliance with drilling safety requirements (complete entire checklist).
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in SOP HSE-35.

SECTION 1 - SAFE WORK PRACTICES (4.1)

	Yes	No	N/A	N/O
1. Personnel cleared during rig startup	☐	☐	☐	☐
2. Personnel clear of rotating parts	☐	☐	☐	☐
3. Personnel not positioned under hoisted loads	☐	☐	☐	☐
4. Loose clothing and jewelry removed	☐	☐	☐	☐
5. Smoking is prohibited around drilling operation	☐	☐	☐	☐
6. Personnel wearing appropriate personal protective equipment (PPE), per written plan	☐	☐	☐	☐
7. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐

SECTION 2 - SUPPORT FUNCTIONS (4.2)

FORMS/PERMITS (4.2.1)

8. Driller license certification obtained	☐	☐	☐	☐
9. Well development abandonment notifications and logs submitted and in project files	☐	☐	☐	☐
10. Water withdrawal permit obtained, where required	☐	☐	☐	☐
11. Dig permit obtained, where required	☐	☐	☐	☐

UTILITY LOCATING (4.2.2)

12. Location of underground utilities and structures identified	☐	☐	☐	☐

SECTION 2 (Continued)

	Yes	No	N/A	N/O
WASTE MANAGEMENT (4.2.3)				
13. Drill cuttings and purge water managed and disposed properly	☐	☐	☐	☐
DRILLING AT HAZARDOUS WASTE SITES (4.2.4)				
14. Waste disposed of according to project's written safety plan	☐	☐	☐	☐
15. Appropriate decontamination procedures being followed, per project's written safety plan	☐	☐	☐	☐
DRILLING AT ORDNANCE EXPLOSIVES (OE)/UNEXPLODED ORDNANCE (UXO) SITES (4.2.5)				
16. OE plan prepared and approved	☐	☐	☐	☐
17. OE UXO avoidance provided, routes and boundaries cleared and marked	☐	☐	☐	☐
18. Initial pilot hole established by UXO technician with hand auger	☐	☐	☐	☐
19. Personnel remain inside cleared areas	☐	☐	☐	☐

SECTION 3 - DRILLING SAFETY REQUIREMENTS (4.3)

GENERAL (4.3.1)				
20. Only authorized personnel operating drill rigs	☐	☐	☐	☐
21. Daily safety briefing meeting conducted with crew	☐	☐	☐	☐
22. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
DRILL RIG PLACEMENT (4.3.2)				
23. Location of underground utilities and structures identified	☐	☐	☐	☐
24. Safe clearance distance maintained from overhead power lines	☐	☐	☐	☐
25. Drilling pad established, when necessary	☐	☐	☐	☐
26. Drill rig leveled and stabilized	☐	☐	☐	☐
27. Additional precautions taken when drilling in confined areas	☐	☐	☐	☐
DRILL RIG TRAVEL (4.3.3)				
28. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
29. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
30. Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
31. Safe clearance distance maintained while traveling under overhead power lines	☐	☐	☐	☐
32. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
DRILL RIG OPERATION (4.3.4)				
33. Kill switch clearly identified and operational	☐	☐	☐	☐
34. All machine guards are in place	☐	☐	☐	☐
35. Rig ropes not wrapped around body parts	☐	☐	☐	☐
36. Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
37. Drill operation stopped during inclement weather	☐	☐	☐	☐
38. Air monitoring conducted per written safety plan for hazardous atmospheres	☐	☐	☐	☐
39. Rig placed in neutral when operator not at controls	☐	☐	☐	☐
DRILL RIG SITE CLOSURE (4.3.5)				
40. Ground openings holes filled or barricaded	☐	☐	☐	☐
41. Equipment and tools properly stored	☐	☐	☐	☐
42. All vehicles locked and keys removed	☐	☐	☐	☐
DRILL RIG MAINTENANCE (4.3.6)				
28. Defective components repaired immediately	☐	☐	☐	☐
29. Lockout tagout procedures used prior to maintenance	☐	☐	☐	☐
30. Cathead in clean, sound condition	☐	☐	☐	☐
31. Drill rig ropes in clean, sound condition	☐	☐	☐	☐
32. Fall protection used for fall exposures of 6 feet (U.S.) 1.5 meters (Australia) or greater	☐	☐	☐	☐
33. Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
34. Good housekeeping maintained on and around rig	☐	☐	☐	☐

SECTION 4

Complete this section for all items checked "No" in previous sections. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: ______________________ Project Manager: ______________________

CH2MHILL

H&S Self-Assessment Checklist – HAND AND POWER TOOLS

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees are exposed to hand and power tool hazards and or 2) CH2M HILL provides oversight of subcontractor personnel who are exposed to hand and power tool hazards.

SSC or DSC may consult with subcontractors when completing this checklist, but shall not direct the means and methods of hand and power tool use nor direct the details of corrective actions. Subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the HS&E Staff for review.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposure to hand and power tool hazards.
☐ Evaluate a CH2M HILL subcontractor's compliance with hand and power tool requirements.
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete correct.
- Check "No" if an item is incomplete deficient. Deficiencies shall be brought to the immediate attention of the subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-50.

SECTION 1

	Yes	No	N/A	N/O
SAFE WORK PRACTICES (3.1)				
1. All tools operated according to manufacturer's instructions and design limitations.	☐	☐	☐	☐
2. All hand and power tools maintained in a safe condition and inspected and tested before use.	☐	☐	☐	☐
3. Defective tools are tagged and removed from service until repaired.	☐	☐	☐	☐
4. PPE is selected and used according to tool-specific hazards anticipated.	☐	☐	☐	☐
5. Power tools are not carried or lowered by their cord or hose.	☐	☐	☐	☐
6. Tools are disconnected from energy sources when not in use, servicing, cleaning, etc.	☐	☐	☐	☐
7. Safety guards remain installed or are promptly replaced after repair.	☐	☐	☐	☐
8. Tools are stored properly.	☐	☐	☐	☐
9. Cordless tools and recharging units both conform to electrical standards and specifications	☐	☐	☐	☐
10. Tools used in explosive environments are rated for such use.	☐	☐	☐	☐
11. Knife or blade hand tools are used with the proper precautions.	☐	☐	☐	☐
12. Consider controls to avoid muscular skeletal, repetitive motion, and cumulative trauma stressors.	☐	☐	☐	☐

H&S Self-Assessment Checklist – HAND AND POWER TOOLS

SECTION 2	Yes	No	N/A	N/O
GENERAL (3.2.1)				
13. PPE is selected and used according to tool-specific hazards anticipated.	☐	☐	☐	☐
14. Tools are tested daily to assure safety devices are operating properly.	☐	☐	☐	☐
15. Damaged tools are removed from service until repaired.	☐	☐	☐	☐
16. Power operated tools designed to accommodate guards have guards installed.	☐	☐	☐	☐
17. Rotating or moving parts on tools are properly guarded.	☐	☐	☐	☐
18. Machines designed for fixed locations are secured or anchored.	☐	☐	☐	☐
19. Floor and bench-mounted grinders are provided with properly positioned work rests.	☐	☐	☐	☐
20. Guards are provided at point of operation, nip points, rotating parts, etc.	☐	☐	☐	☐
21. Fluid used in hydraulic-powered tools is approved fire-resistant fluid.	☐	☐	☐	☐
ELECTRIC-POWERED TOOLS (3.2.2)				
22. Electric tools are approved double insulated or grounded and used according to SOP HS-23.	☐	☐	☐	☐
23. Electric cords are not used for hoisting or lowering tools.	☐	☐	☐	☐
24. Electric tools are used in damp wet locations are approved for such locations or GFCI installed.	☐	☐	☐	☐
25. Hand-held tools are equipped with appropriate on off controls appropriate for the tool.	☐	☐	☐	☐
26. Portable, power-driven circular saws are equipped with proper guards.	☐	☐	☐	☐
ABRASIVE WHEEL TOOLS (3.2.3)				
27. All employees using abrasive wheel tools are wearing eye protection.	☐	☐	☐	☐
28. All grinding machines are supplied with sufficient power to maintain spindle speed.	☐	☐	☐	☐
29. Abrasive wheels are closely inspected and ring-tested before use.	☐	☐	☐	☐
30. Grinding wheels are properly installed.	☐	☐	☐	☐
31. Cup-type wheels for external grinding are protected by the proper guard or flanges.	☐	☐	☐	☐
32. Portable abrasive wheels used for internal grinding are protected by safety flanges.	☐	☐	☐	☐
33. Safety flanges are used only with wheels designed to fit the flanges.	☐	☐	☐	☐
34. Safety guards on abrasive wheel tools are mounted properly and of sufficient strength.	☐	☐	☐	☐
PNEUMATIC-POWERED TOOLS (3.2.4)				
35. Tools are secured to hoses or whip by positive means to prevent disconnection.	☐	☐	☐	☐
36. Safety clips or retainers are installed to prevent attachments being expelled.	☐	☐	☐	☐
37. Safety devices are installed on automatic fastener feed tools as required.	☐	☐	☐	☐
38. Compressed air is not used for cleaning unless reduced to < 30 psi, with PPE, and guarded.	☐	☐	☐	☐
39. Manufacturer's safe operating pressure for hoses, pipes, valves, etc. are not exceeded.	☐	☐	☐	☐
40. Hoses are not used for hoisting or lowering tools.	☐	☐	☐	☐
41. All hoses > 1 2-inch diameter have safety device at source to reduce pressure upon hose failure.	☐	☐	☐	☐
42. Airless spray guns have required safety devices installed.	☐	☐	☐	☐
43. Blast cleaning nozzles are equipped with operating valves, which are held open manually.	☐	☐	☐	☐
44. Supports are provided for mounting nozzles when not in use.	☐	☐	☐	☐
45. Air receiver drains, handholes, and manholes are easily accessible.	☐	☐	☐	☐
46. Air receivers are equipped with drainpipes and valves for removal of accumulated oil and water.	☐	☐	☐	☐
47. Air receivers are completely drained at required intervals.	☐	☐	☐	☐
48. Air receivers are equipped with indicating pressure gauges.	☐	☐	☐	☐
49. Safety, indicating, and controlling devices are installed as required.	☐	☐	☐	☐
50. Safety valves are tested frequently and at regular intervals to assure good operating condition.	☐	☐	☐	☐

SECTION 2 (continued)

	Yes	No	N/A	N/O
LIQUID FUEL-POWERED TOOLS (3.2.5)				
51. Liquid fuel-powered tools are stopped when refueling, servicing, or maintaining.	☐	☐	☐	☐
52. Liquid fuels are stored, handled, and transported in accordance with SOP HS-21	☐	☐	☐	☐
53. Liquid fuel-powered tools are used in confined spaces in accordance with SOP HS-17.	☐	☐	☐	☐
54. Safe operating pressures of hoses, valves, pipes, filters, and other fittings are not exceeded.	☐	☐	☐	☐
POWDER-ACTUATED TOOLS (3.2.6)				
55. Only trained employee operates powder-actuated tools.	☐	☐	☐	☐
56. Powder-actuated tools are not loaded until just prior to intended firing time.	☐	☐	☐	☐
57. Tools are not pointed at any employee at any time.	☐	☐	☐	☐
58. Hands are kept clear of open barrel end.	☐	☐	☐	☐
59. Loaded tools are not left unattended.	☐	☐	☐	☐
60. Fasteners are not driven into very hard or brittle materials.	☐	☐	☐	☐
61. Fasteners are not driven into easily penetrated materials unless suitable backing is provided.	☐	☐	☐	☐
62. Fasteners are not driven into spalled areas.	☐	☐	☐	☐
63. Powder-actuated tools are not used in an explosive or flammable atmosphere.	☐	☐	☐	☐
64. All tools are used with correct shields, guards, or attachments recommended by manufacturer.	☐	☐	☐	☐
JACKING TOOLS (3.2.7)				
65. Rated capacities are legibly marked on jacks and not exceeded.	☐	☐	☐	☐
66. Jacks have a positive stop to prevent over-travel.	☐	☐	☐	☐
67. The base of jacks are blocked or cribbed to provide a firm foundation, when required.	☐	☐	☐	☐
68. Wood blocks are place between the cap and load to prevent slippage, when required.	☐	☐	☐	☐
69. After load is raised, it is cribbed, blocked, or otherwise secured immediately.	☐	☐	☐	☐
70. Antifreeze is used when hydraulic jacks are exposed to freezing temperatures.	☐	☐	☐	☐
71. All jacks are properly lubricated.	☐	☐	☐	☐
72. Jacks are inspected as required.	☐	☐	☐	☐
73. Repair or replacement parts are examined for possible defects.	☐	☐	☐	☐
74. Jacks not working properly are removed from service and repaired or replaced.	☐	☐	☐	☐
HAND TOOLS (3.2.8)				
75. Wrenches are not used when jaws are sprung to the point of slippage.	☐	☐	☐	☐
76. Impact tools are kept free of mushroomed heads.	☐	☐	☐	☐
77. Wooden handles of tools are kept free of splinters or cracks and are tightly fitted in tool.	☐	☐	☐	☐

H&S Self-Assessment Checklist – HAND AND POWER TOOLS

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _____ Project Manager: _____

CH2MHILL

HS&E Self-Assessment Checklist—Non-Hazardous Waste Management

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP FSI.

This checklist is to be used at locations where:
1) CH2M HILL employees are exposed to non-hazardous waste hazards and or
2) CH2M HILL provides oversight of subcontractor personnel who are engaged in non-hazardous waste operations.

SC-HW or SC-C may consult with subcontractors when completing this checklist, but shall not direct the means and methods of asbestos operations nor direct the details of corrective actions. Subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazard until corrected.

Completed checklists shall be sent to the HS&E Staff for review.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposure to non-hazardous waste
☐ Evaluate a CH2M HILL subcontractor's compliance with the non-hazardous waste management standards and its requirements
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete correct.
- Check "No" if an item is incomplete deficient. Deficiencies shall be brought to the immediate attention of the subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-81.

SECTION 1

	Yes	No	N/A	N/O
SOURCE REDUCTION AND RECYCLING (6.1 and 6.2)				
1. Products have been re-used to reduce waste quantity and toxicity	☐	☐	☐	☐
2. Material volumes have been reduced by using less packaging	☐	☐	☐	☐
3. Less toxic products have been used to reduce waste toxicity	☐	☐	☐	☐
4. Materials at CH2M HILL offices are recycled	☐	☐	☐	☐
5. Recyclables generated at project sites are recycled	☐	☐	☐	☐

SECTION 2	Yes	No	N/A	N/O
STORAGE (6.3)				
6. Local or state solid waste storage requirements have been identified	☐	☐	☐	☐
7. Local and state solid waste stockpile requirements have been identified	☐	☐	☐	☐
8. Solid waste containers meet DOT specifications	☐	☐	☐	☐
9. Non-hazardous waste label used for containers of non-hazardous waste	☐	☐	☐	☐
DISPOSAL (6.4)				
Construction and Demolition Debris (6.4.1)				
10. Construction debris is disposed of at a landfill permitted to take C&D debris	☐	☐	☐	☐
11. Clean C&D debris is reused	☐	☐	☐	☐
12. C&D debris considered for recycling	☐	☐	☐	☐
13. C&D debris containing hazardous substance is managed under HSE-79	☐	☐	☐	☐
Lead-Contaminated Waste (6.4.2)				
14. Lead-based paint debris managed under HSE-78 and HSE-79	☐	☐	☐	☐
Petroleum-Contaminated Soil (6.4.3)				
15. ECC consulted for treatment, disposal and recycling options for petroleum-contaminated soil	☐	☐	☐	☐
Well Water Onsite Treatment and Discharge (6.4.4.1)				
16. Non-hazardous well purge development water treated in existing NPDES-permitted system	☐	☐	☐	☐
17. Non-hazardous water is discharged to sewer untreated with POTW approval	☐	☐	☐	☐
18. Non-hazardous waste is discharged to onsite wastewater pretreatment system	☐	☐	☐	☐
19. Treatment of hazardous wastewater meets requirements of RCRA wastewater treatment unit	☐	☐	☐	☐
Discharge at Offsite POTW/FOTW (6.4.4.2)				
20. Discharged water is classified using "client" knowledge and or testing	☐	☐	☐	☐
21. The water is not ignitable, does not contain organics or have an oily sheen	☐	☐	☐	☐
22. Client provided written notice to POTW that water meets acceptance limits	☐	☐	☐	☐
23. POTW discharge approval received in writing	☐	☐	☐	☐
24. POTW EPA ID number obtained for hazardous wastewater	☐	☐	☐	☐
25. Hazardous waste manifest used for transport of hazardous waste to POTW	☐	☐	☐	☐
26. Waste meets pre-treatment requirements	☐	☐	☐	☐
Discharge to Injection Galleries/Injection Wells (6.4.4.3)				
27. Permit or approval obtained for discharge to injection gallery or well	☐	☐	☐	☐
28. Purge water originated from wells at the site (same aquifer with same chemical properties)	☐	☐	☐	☐
29. The purge water is non-hazardous or exempt from hazardous waste regulations	☐	☐	☐	☐
30. Injection gallery at site is operating under state permit or approval from EPA	☐	☐	☐	☐
Discharge to Ground Surface (6.4.4.4)				
31. Discharged water is classified using "Client" knowledge and or testing	☐	☐	☐	☐
32. Purge water is not a RCRA or state hazardous waste	☐	☐	☐	☐
33. Written approval received from the client	☐	☐	☐	☐
34. State permit or approval received for discharge	☐	☐	☐	☐
35. Carbon filtration used prior to discharge to the ground surface	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: ______________________ Project Manager: ______________________

Attachment 4:

Project-Specific Chemical Product Hazard Communication Form

CH2MHILL - Attachment 4

Project-Specific Chemical Product Hazard Communication Form

This form must be completed prior to performing activities that expose personnel to hazardous chemicals products. Upon completion of this form, the SSC shall verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to CH2M HILL and subcontractor personnel. Labeling and MSDS systems will also be explained.

Project Name: Former Celotex Facility, Chicago, Illinois **Project Number:** 327757

MSDSs will be maintained at the following location(s): In company/employee vehicle

Hazardous Chemical Products Inventory

Chemical	Quantity	Location	MSDS Available	Container labels	
				Identity	Hazard

Refer to SOP HS-05 *Hazard Communication* for more detailed information.

Attachment 5:

Applicable Material Safety Data Sheets

Attachment 6:

Chemical-Specific Training Form

CH2MHILL ATTACHMENT 6

CHEMICAL-SPECIFIC TRAINING FORM

Location: Former Celotex Facility, Chicago, Illinois	Project # : 327757
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

Attachment 7:

Incident Report Form and Root Cause Investigation Information

CH2M HILL

Incident Report Form (Hardcopy)

Fax completed form to:
425.462.5957
CH2M HILL Seattle Office
Attention: Corporate HS&E Department

Type of Incident (Select at least one)

- ☐ Injury/Illness
- ☐ Property Damage
- ☐ Spill/Release
- ☐ Environmental/Permit Issue
- ☐ Near Miss
- ☐ Other

General Information (Complete for all incident types)

Preparer's Name: _____ Preparer's Employee Number: _____
Date of Report: _____ Date of Incident: _____ Time of Incident: _____ am/pm

Type of Activity (Provide activity being performed that resulted in the incident)

- ☐ Asbestos Work
- ☐ Confined Space Entry
- ☐ Construction Mgmt- Haz Waste
- ☐ Construction Mgmt - Non-Haz Waste
- ☐ Demolition
- ☐ Drilling-Haz Waste
- ☐ Drilling-Non Haz Waste
- ☐ Drum Handling
- ☐ Electrical Work
- ☐ Excavation Trench-Haz Waste
- ☐ Excavation Trench-Non Haz
- ☐ Facility Walk Through
- ☐ General Office Work
- ☐ Keyboard Work
- ☐ Laboratory
- ☐ Lead Abatement
- ☐ Motor Vehicle Operation
- ☐ Moving Heavy Object
- ☐ Other (Specify) _____
- ☐ Process Safety Management
- ☐ Tunneling
- ☐ Welding
- ☐ Wetlands Survey
- ☐ Working from Heights
- ☐ Working in Roadways
- ☐ WWTP Operation

Location of Incident (Select one)

- ☐ Company Premises (CH2M HILL Office: _____)
- ☐ Field (Project #: _____ Project/Site Name: _____ Client: _____)
- ☐ In Transit (Traveling from: _____ Traveling to: _____)
- ☐ At Home

Geographic Location of Incident (Select region where the incident occurred)

- ☐ Northeast
- ☐ Southeast
- ☐ Northwest
- ☐ Southwest
- ☐ Corporate
- ☐ Canadian
- ☐ Asia Pacific
- ☐ Europe Middle East
- ☐ Latin America

If a CH2M HILL subcontractor was involved in the incident, provide their company name and phone number: _____

Describe the Incident (Provide a brief description of the incident): _____

_____

_____

Injured Employee Data (Complete for Injury/Illness incidents only)

If CH2M HILL employee injured

Employee Name: _____ Employee Number: _____

If CH2M HILL Subcontractor employee injured

Employee Name: _____ Company: _____

Injury Type

- ☐ Allergic Reaction
- ☐ Amputation
- ☐ Asphyxia
- ☐ Bruise/Contusion/Abrasion
- ☐ Burn (Chemical)
- ☐ Burn/Scald (Heat)
- ☐ Cancer
- ☐ Carpal Tunnel
- ☐ Concussion
- ☐ Cut/Laceration
- ☐ Dermatitis
- ☐ Dislocation
- ☐ Electric Shock
- ☐ Foreign Body in eye
- ☐ Fracture
- ☐ Freezing/Frost Bite
- ☐ Headache
- ☐ Hearing Loss
- ☐ Heat Exhaustion
- ☐ Hernia
- ☐ Infection
- ☐ Irritation to eye
- ☐ Ligament Damage
- ☐ Multiple (Specify)

_____

- ☐ Muscle Spasms
- ☐ Other (Specify)

_____

- ☐ Poisoning (Systemic)
- ☐ Puncture
- ☐ Radiation Effects
- ☐ Strain/Sprain
- ☐ Tendonitits
- ☐ Wrist Pain

Part of Body Injured

- ☐ Abdomen
- ☐ Ankle(s)
- ☐ Arms (Multiple)
- ☐ Back
- ☐ Blood
- ☐ Body System
- ☐ Buttocks
- ☐ Chest/Ribs
- ☐ Ear(s)
- ☐ Elbow(s)
- ☐ Eye(s)
- ☐ Face
- ☐ Finger(s)
- ☐ Foot/Feet
- ☐ Hand(s)
- ☐ Head
- ☐ Hip(s)
- ☐ Kidney
- ☐ Knee(s)
- ☐ Leg(s)
- ☐ Liver
- ☐ Lower (arms)
- ☐ Lower (legs)
- ☐ Lung
- ☐ Mind
- ☐ Multiple (Specify)

_____

- ☐ Neck
- ☐ Nervous System
- ☐ Nose
- ☐ Other (Specify)

_____

- ☐ Reproductive System
- ☐ Shoulder(s)
- ☐ Throat
- ☐ Toe(s)
- ☐ Upper Arm(s)
- ☐ Upper Leg(s)
- ☐ Wrist(s)

Nature of Injury

- ☐ Absorption
- ☐ Bite/Sting/Scratch
- ☐ Cardio-Vascular/Respiratory System Failure
- ☐ Caught In or Between
- ☐ Fall (From Elevation)
- ☐ Fall (Same Level)
- ☐ Ingestion
- ☐ Inhalation
- ☐ Lifting
- ☐ Mental Stress
- ☐ Motor Vehicle Accident
- ☐ Multiple (Specify)

_____

- ☐ Other (Specify)

_____

- ☐ Overexertion
- ☐ Repeated Motion/Pressure
- ☐ Rubbed/Abraded
- ☐ Shock
- ☐ Struck Against
- ☐ Struck By
- ☐ Work Place Violence

Initial Diagnosis/Treatment Date: _____

Type of Treatment

- ☐ Admission to hospital/medical facility
- ☐ Application of bandages
- ☐ Cold/Heat Compression/Multiple Treatment
- ☐ Cold/Heat Compression/One Treatment
- ☐ First Degree Burn Treatment
- ☐ Heat Therapy/Multiple treatment
- ☐ Multiple (Specify)

_____

- ☐ Heat Therapy/One Treatment
- ☐ Non-Prescriptive medicine
- ☐ None
- ☐ Observation
- ☐ Other (Specify)

_____

- ☐ Prescription- Multiple dose
- ☐ Prescription- Single dose
- ☐ Removal of foreign bodies
- ☐ Skin Removal
- ☐ Soaking therapy - Multiple Treatment
- ☐ Soaking Therapy - One Treatment
- ☐ Stitches/Sutures
- ☐ Tetanus
- ☐ Treatment for infection
- ☐ Treatment of 2nd / 3rd degree burns
- ☐ Use of Antiseptics - multiple treatment
- ☐ Use of Antiseptics - single treatment
- ☐ Whirlpool bath therapy / multiple treatment
- ☐ Whirlpool therapy / single treatment
- ☐ X-rays negative
- ☐ X-rays positive/treatment of fracture

Number of days doctor required employee to be off work: _____
Number of days doctor restricted employee's work activity: _____
Equipment Malfunction : Yes ☐ No ☐ Activity was a Routine Task: Yes ☐ No ☐
Describe how you may have prevented this injury: _____

Physician Information
Name: _____
Address: _____
City: _____
Zip Code: _____
Phone: _____

Hospital Information
Name: _____
Address: _____
City: _____
Zip Code: _____
Phone: _____

Property Damage (Complete for Property Damage incidents only)

Property Damaged: _____ Property Owner: _____
Damage Description: _____
Estimated Amount: $ _____

Spill or Release (Complete for Spill/Release incidents only)

Substance (attach MSDS): _____ Estimated Quantity: _____
Facility Name, Address, Phone No.: _____
Did the spill/release move off the property where work was performed?: _____
Spill/Release From: _____ Spill/Release To: _____

Environmental/Permit Issue (Complete for Environmental/Permit Issue incidents only)

Describe Environmental or Permit Issue: _____
Permit Type: _____
Permitted Level or Criteria (e.g., discharge limit): _____
Permit Name and Number (e.g., NPDES No. ST1234): _____
Substance and Estimated Quantity: _____
Duration of Permit Exceedence: _____

Verbal Notification (Complete for all incident types)(Provide names, dates and times)

CH2M HILL Personnel Notified: _____
Client Notified: _____

Witnesses (Complete for all incident types)

Witness Information (First Witness)
Name: _____
Employee Number (CH2M HILL): _____
Address: _____
City: _____
Zip Code: _____
Phone: _____

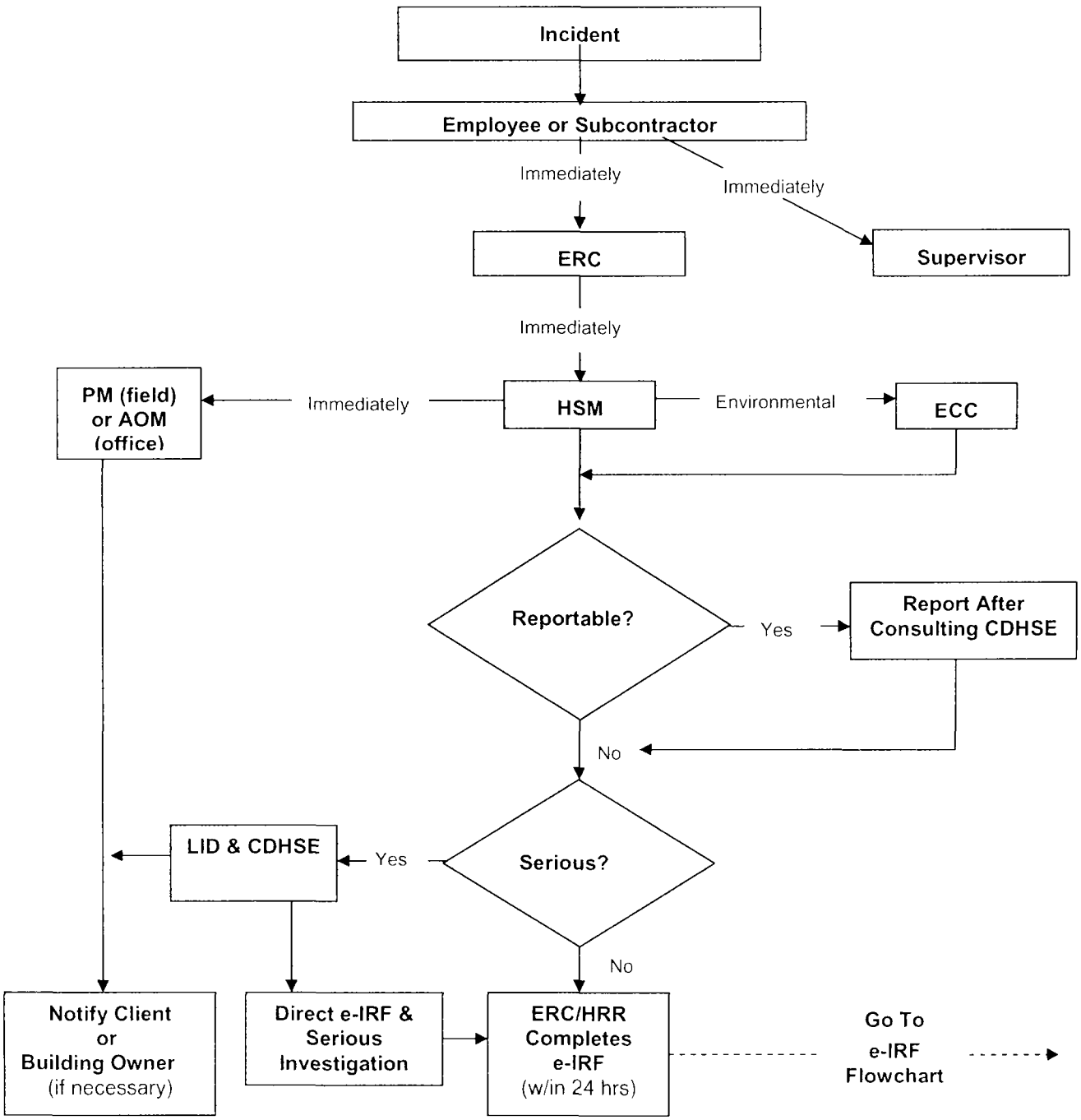
Witness Information (Second Witness)
Name: _____
Employee Number (CH2M HILL: _____
Address: _____
City: _____
Zip Code: _____
Phone : _____

Additional Comments:
_____
_____
_____
_____

CH2MHILL

Incident Reporting and Investigation
Standard of Practice HSE-111

Attachment 2: Incident Notification and Reporting Flowchart



Appendix B: Investigation Guidelines

1.0 Introduction

This guideline is provided to assist in accessing, completing, and reviewing an incident investigation. It is important to remember the following when conducting an investigation:

- Gather relevant facts, focusing on fact finding, not fault finding.
- Draw conclusions, pitting facts together into a probable scenario.
- Determine incident root cause(s), which are basic causes on why an unsafe act/condition existed.
- Develop and implement solutions, matching all identified root causes with solutions.

2.0 Documentation

The following should be included in the IRF to document the incident.

Description

- Provide a description of the event and the sequence of events and actions that took place prior to the incident. Start with the incident event and work backwards in time through all of the preceding events that directly contributed to the incident. The information should identify why the event took place as well as who was involved, when and where the event took place, and what actions were taken.

Cause Analysis

Using the form and flowchart in Attachment 1, the root cause of the incident will be determined. This form must be retained in the project and/or regional HS&E files.

Immediate Causes—List the substandard actions or conditions that directly affected the incident. The following are examples of immediate causes:

> *Substandard Actions*: Operating equipment without authority; failure to warn; failure to secure; operating at improper speed; making safety device inoperable; using defective equipment; failing to use PPE; improper loading; improper lifting; improper position for task; under influence of alcohol or drugs; horseplay.
>
> *Substandard Conditions:* Exposure to hazardous materials; exposure to extreme temperatures; improper lighting; improper ventilation; congestion; exposure to fire and explosive hazard; defective tools, equipment, or materials; exposure to extreme noise; poor ventilation; poor visibility; poor housekeeping.

Basic Causes—List the personal and job factors that caused the incident. The following are examples of basic causes:

Personal Factors: Capability; knowledge; skill; stress; motivation.

Job Factors: Abuse or misuse; engineering; maintenance; purchasing; supervision; tools and equipment; wear and tear; work standards.

Corrective Action Plan

Include all corrective actions taken or those that should be taken to prevent recurrence of the incident. Include the specific actions to be taken, the employer and personnel responsible for implementing the actions, and a time frame for completion. Be sure the corrective actions address the causes. For example, training may prevent recurrence of an incident caused by a lack of knowledge, but it may not help an incident caused by improper motivation.

The following are examples of management programs that may be used to control future incidents. These programs should be considered when determining specific corrective actions.

Management Programs: Accident/incident analysis; emergency preparedness; engineering controls; general promotion; group meetings; health control; hiring and placement; leadership and administration; management training; organizational rules; personal protective equipment; planned inspections; program audits; program controls; purchasing controls; task analysis and procedures; task observation

3.0 Attachments

Attachment B-1 Root Cause Analysis Form and Flowchart

CH2MHILL

Incident Reporting and Investigation
Standard of Practice HSE-111
Appendix B: Investigation Guidelines

Attachment B-1: Root Cause Analysis Form and Flowchart

Root Cause Analysis Form

Root Cause Analysis (RCA)

Root Cause Categories (RCC): Select the RCC numbered below that applies for the root cause (RC) and/or contributing factor (CF) in the first column, then describe the specific root cause and corrective actions in each column.

1. Lack of skill or knowledge
2. Lack of or inadequate operational procedures or work standards
3. Inadequate communication of expectations regarding procedures or work standards
4. Inadequate tools or equipment
5. Correct way takes more time and/or requires more effort
6. *Short-cutting standard procedures is positively reinforced or tolerated*
7. Person thinks there is no personal benefit to always doing the job according to standards

RCC #	Root Cause(s)	Corrective Actions	RC[1]	CF[2]	Due Date	Completion Date	Date Verified

[1] RC = Root Cause; [2] CF = Contributing Factors (check which applies)

Investigation Team Members

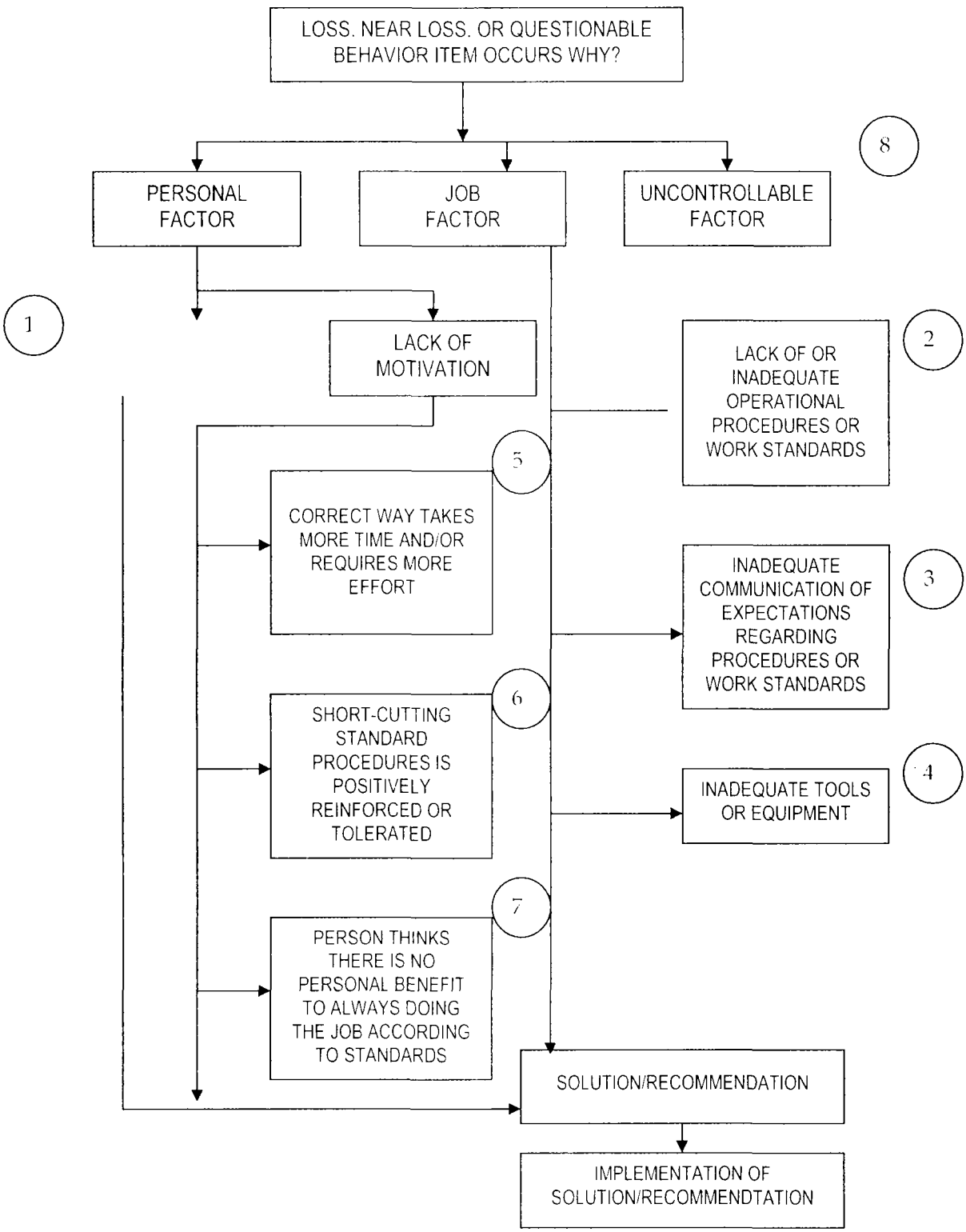
Name	Job Title	Date

Results of Solution Verification and Validation

Reviewed By

Name	Job Title	Date

Root Cause Analysis Flowchart


LOSS. NEAR LOSS. OR QUESTIONABLE BEHAVIOR ITEM OCCURS WHY?
8
PERSONAL FACTOR
JOB FACTOR
UNCONTROLLABLE FACTOR
1
LACK OF MOTIVATION
2
LACK OF OR INADEQUATE OPERATIONAL PROCEDURES OR WORK STANDARDS
5
CORRECT WAY TAKES MORE TIME AND/OR REQUIRES MORE EFFORT
3
INADEQUATE COMMUNICATION OF EXPECTATIONS REGARDING PROCEDURES OR WORK STANDARDS
6
SHORT-CUTTING STANDARD PROCEDURES IS POSITIVELY REINFORCED OR TOLERATED
4
INADEQUATE TOOLS OR EQUIPMENT
7
PERSON THINKS THERE IS NO PERSONAL BENEFIT TO ALWAYS DOING THE JOB ACCORDING TO STANDARDS
SOLUTION/RECOMMENDATION
IMPLEMENTATION OF SOLUTION/RECOMMENDTATION

Attachment 8:

Emergency Contacts and Hospital Route Map

Emergency Contacts - Attachment 8

24-hour CH2M HILL Emergency Response Telephone

Medical Emergency – 911

Fire/Spill Emergency -- 911

Security & Police – 911

Local Facility Emergency Response Number:

CH2M HILL Medical Consultant
Health Resources
Dr. Jerry H. Berke, M.D., M.P.H.
600 West Cummings Park, Suite 3400
Woburn, MA 01801-6350
1-781-938-4653 (8 am to 11 pm EST)
1-800-350-4511 (after hours and on weekends)
(After hours calls will be returned within 20 minutes)

Honeywell Health, Safety & Environment Manager
Name: Bill Berlett/CHI
Phone: 773-693-3800 x 316
Cell: 847-770-0209
Fax: 773-693-3823

Environmental Compliance Coordinator (ECC)
Name: Linda Hickok/SYR
Phone: (315) 422-7250 x229

Project Health & Safety Manager (HSM)
Name: Bill Berlett/CHI
Phone: 773-693-3800 x 316
Cell: 847-770-0209
Fax: 773-693-3823

Safety Coordinator (SC)
Name: TBD
Phone:

Project Manager (PM)
Name: Joel Wipf/CHI
Phone: 773-693-3800x253
Cell: 773-793-0468

Regional Human Resources Department (Workers' Compensation Contact)
Name: Cindy Bauder/WDC
Phone: 703/471-6405 ext. 4243

Federal Express Dangerous Goods Shipping
Phone: 800/238-5355

CH2M HILL Emergency Number for Shipping Dangerous Goods
Phone: 800/255-3924

Worker's Compensation:
Contact Regional HR dept. to have form completed or contact Albert Jerman after hours: 303-741-5927

Automobile Accidents:
Rental: Carol Dietz/COR 303/713-2757
CH2M HILL owned vehicle:
Zurich Insurance Co. 800-987-3373

Contact the PM. Generally, the PM will contact relevant government agencies.

Facility Alarms: N/A

Evacuation Assembly Area(s): TBD by SC

Facility/Site Evacuation Route(s): TBD by SC

Hospital Name/Address:
Mt. Sanai
1501 S. California
Chicago, Illinois
Phone:773-542-2000

Directions to Hospital

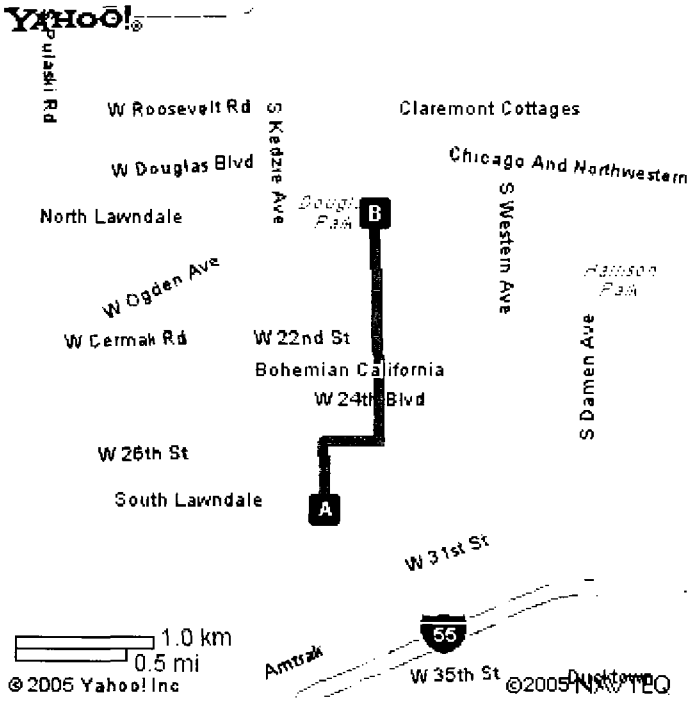
See map on following page

Celotex, Chicago, Illinois

Hospital Route Map and Directions

From the site travel north on Sacramento approximately three blocks to 25th Street. Turn right and travel east on 25th Street approximately 2 blocks to California Avenue. Turn left on California and travel north approximately one mile to the hospital, which will be on the right side of the street.

Please Note: The above directions start at the former Celotex facility address at 2800 S. Sacramento Avenue. The starting direction shall change as the location of exact site changes. Please ensure that all field workers are aware of this change. The map below is given for reference.



Attachment 9:

Project H&S Forms/Permits

CH2M HILL
Daily Tailgate Safety Briefing Form

Project Name:	Project Number:	
Date:	Start Time:	Completed Time:
Site Location:		
Type of Work (general):		

Safety Issues

Tasks (this shift):
PPE Requirements:
Chemical Hazards:
Air Monitoring Requirements:
Physical Hazards:
Control Measures:
Hazard Communication Overview (MSDSs):
Special Topics (i.e., incidents, near misses, etc.)

Daily Checklist

HSE Plan up to date and present onsite?	Yes	No
Air monitoring equipment present, working, and calibrated?	Yes	No
Personnel training current?	Yes	No
Hospital Route Map and Emergency Phone Numbers posted onsite?	Yes	No
PPE present and worn by personnel?	Yes	No
Comments:		

Attendees

Print Name	Sign Name
Meeting conducted by:	

Attachment 10:

Drug Testing Hospital Kit Notice

HOSPITAL KIT NOTICE

You are receiving this package because you are listed as a Project Manager and/or Superintendent/CM who is managing a CCI project or an INC project which requires drug testing. The items in the package, known as a 'hospital kit', are needed if there is a serious injury requiring medical care on your project.

It is your responsibility to make certain that this hospital kit is onsite at all times while operations and maintenance activities are in progress at the site.

For minor injuries - Hospital Kits are **NOT** required. After the injury is treated, the injured employee will be tested at the emergency care clinic or you can take the injured employee to the usual laboratory collection facility listed below. Both the emergency care clinic and the laboratory collection facility already have drug testing kits and you will only be responsible to provide them with your normal Custody and Control Form (CCF) in order for the employee to be tested.

For more serious injuries that require hospital, ambulance, or paramedic care, we need to provide the collector with the 'hospital kit' in order for the drug test specimen to be properly collected. This package *contains everything that the medical provider will need* to collect the sample. It is critical that the 'hospital kit' accompanies all injured employee(s) to the hospital so they will get drug tested. If more than one employee is injured, you must send one kit for each employee that is to receive care at the hospital. After the kit is used, you must immediately contact Elaine Senecal/ORL for CCI projects or Jeannie Armstrong/SEA for INC projects to get a replacement kit. These kits must remain onsite and be available for emergencies at all times.

Location for Chicago:

CH2M HILL Personnel also need on-line training:

http://www.int.ch2m.com/safety_counts/Training_Basic_Modules/Drug_desc.html

APPENDIX B

Sampling and Analysis Plan

FINAL

SAMPLING AND ANALYSIS PLAN

For the
Residential Study Area
Near the
Former Celotex Site
2800 South Sacramento Avenue
Chicago, Illinois 60623

Prepared for
Honeywell International Inc.

June 2006

Prepared by

CH2MHILL

Contents

Preface

This Sampling and Analysis Plan (SAP) presents the policies, procedures, functions, and quality assurance/quality control (QA/QC) requirements designed to achieve the data quality for the residential soil sampling study area surrounding the Celotex Site located at 2800 South Sacramento Avenue in Chicago, Illinois. This SAP has been prepared to ensure 1) the data quality objectives are met, 2) the field sampling protocols are documented and reviewed in a consistent manner, and 3) the data that are collected are scientifically valid and defensible. The SAP is divided into 1) the Field Sampling Plan (FSP) and 2) the Quality Assurance Project Plan (QAPP). The FSP describes the activities and procedures to be conducted in the field. The QAPP includes project organization and responsibilities, quality assurance objectives, analytical procedures, and site-specific quality control requirements.

All staff participating in the work effort are required to read this SAP. The SAP will be in the possession of the field teams collecting the samples. All contractors and subcontractors will be required to comply with the procedures documented in this SAP in order to maintain comparability and representativeness of the collected and generated data.

The types of environmental samples collected during the execution of this project include surface and shallow subsurface soil samples, and the following QA/QC samples: 1) equipment blanks, 2) field duplicates, and 3) matrix spike and matrix spike duplicates. All sampling and analyses will be performed in accordance with QAPP.

APPENDIX B-1

Field Sampling Plan

FINAL

FIELD SAMPLING PLAN

For the
Residential Study Area
Near the
Former Celotex Site
2800 South Sacramento Avenue
Chicago, Illinois 60623

Prepared for
Honeywell International Inc.

June 2006

Prepared by

CH2MHILL

Contents

Acronyms and Abbreviations

bgs	below ground surface
COC	chain-of-custody
EE/CA	*Engineering Evaluation, Cost Analysis*
FSP	field sampling plan
FTL	Field Team Leader
ID	identification
PAH	polycyclic aromatic hydrocarbons
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
SAP	Sampling and Analysis Plan
sf	square feet
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency

SECTION 1

Introduction

1.1 Field Sampling Plan

The Field Sampling Plan (FSP) describes the activities that will be conducted in the field during the Residential Sampling in the areas surrounding the former Celotex Corporation (Celotex) Site in Chicago, Illinois. The location of the Main Site and residential sampling area are illustrated on Figures 1-1 and 1-2 in the Work Plan. The primary activity that will be conducted is surface and shallow subsurface soil sampling and analysis for polycyclic aromatic hydrocarbons (PAHs). Ancillary activities include documentation, sample management, equipment decontamination, waste management, and documentation of field activities. Details of these activities are provided below.

1.2 Site Background/Objectives

The former Celotex Site was used for making, storing and selling asphalt-roofing products. Former operations at the 24-acre Main Site during the approximate period of 1911 to 1989 resulted in the release of PAHs in the air. It is possible that PAH compounds may have migrated through airborne dispersion beyond the Celotex site boundaries and may be present in surface soils in some residential areas surrounding the Site. Facility closure and demolition of the Main Site and subsequent actions have removed the previous source area such that no ongoing releases from the site exist.

Previous actions associated with the Main Site and surrounding residential areas were conducted under a 1996 U. S. Environmental Protection Agency (USEPA) Administrative Order by Consent and concluded with preparation of the required Engineering Evaluation/Cost Analysis (EE/CA). The EE/CA evaluated alternative removal actions pursuant to 40 Code of Federal Regulations 300.415 (b)(4)(i) and the Superfund Accelerated Cleanup Model guidance. The EE/CA was approved by USEPA in 2004 and USEPA subsequently issued an Action Memorandum for the Site on March 7, 2005.

Three residential sampling events were conducted between 1995 and 1999 under USEPA-approved work plans. Surface soil samples were collected from a subset of the residential properties surrounding the Site during these events. The objectives were to obtain data to support risk assessment and background evaluations. Elevated levels of PAHs were documented within some of the residential soils.

USEPA has defined the residential area requiring sampling as within the boundary set by Whipple Avenue, Sacramento Avenue, 28th Street, and 26th Street. In addition, Honeywell International Inc. (Honeywell) has voluntarily agreed to perform sampling within a larger area, although no connection has been made between these areas and the site to date. The residential properties proposed to be sampled within this work plan are bounded by 26th Street to the north, Kedzie Avenue to the west, 31st Street to the south, and the Sacramento

Avenue to the east. This area is referred to as the "residential study area". The location of the Main Site and residential sampling area are illustrated on Figures 1-1 and 1-2 of the Work Plan.

Upon completion of the residential soil sampling proposed herein, a Residential Soil Sampling Report will be developed to document the results of the investigation. The report will be prepared in accordance with Comprehensive Environmental Response, Compensation, and Liability Act guidance and will be submitted to USEPA for review.

The primary objectives of the residential soil sampling investigation are to:

- Implement a soil sampling program to further define the extent of PAH impacts within surface soil and shallow subsurface soil at residential properties near the site,
- Characterize residential properties on a lot-specific and depth-specific basis to assist in removal action planning based on benzo(a)pyrene equivalent concentrations,
- Prepare a Residential Soil Sampling Report to document the results of the investigation.

SECTION 2

Field Activities

2.1 Site Reconnaissance and Preparation

Prior to sample collection activities, information on the individual residential properties will be obtained utilizing the following methods or sources:

- Previously obtained residential property data from the USEPA,
- Previous investigation documents, and
- Aerial photograph review.

The initial review of residential property information will be conducted to assess historical property uses or activities that could influence sampling locations or provide information on how to evaluate sample results. Additional information on the individual properties will be obtained utilizing the past investigation data and available data sources, such as Chicago City Directories, telephone directories, and the Cook County Assessor's Office records accessible from Residential Assessment Search Page located at the Cook County Assessor's Office Interactive Website (http://www.cookcountyassessor.com/ccao/startres.html).

The USEPA has previously contacted and interacted with certain of the area's residential property owners. The process of obtaining access to the residential property will be lead by Honeywell with support from USEPA. Support from the City of Chicago, the local community, government officials, and organized community groups may be sought out for assistance in obtaining access.

Once access agreements have been obtained and utility locations have been identified, a site visit will occur to document current site conditions and collect samples. Upon arrival at each property to be sampled, the field team leader (FTL) will verify that the address on the access agreement matches that of the property. The team will then notify the property occupant(s) of their presence, summarize for them the activities they will be conducting and obtain verbal approval to proceed. If approval is not granted, the FTL will note this in his/her logbook and then proceed to the next location.

Upon approval to proceed, the field team will conduct a site walkover to assess site conditions. The protocols for sample location are given below. The property checklist will be completed. Representative photographs of the property will be taken prior to any intrusive activities. Once locations have been determined, sampling activities will proceed. Sampling at each property will proceed through the same general sequence of steps based on safe work practices and procedures, required soil sampling methods and procedures and minimal disruption and noise to the property occupants and neighborhood. The steps may be changed due to address-specific characteristics, scheduling, access, and other factors. The sampling crew will work with the property occupants to minimize time and impact to each property. The steps expected during the sampling activities are described in Section 3.4 of the Work Plan.

2.2 Surface and Subsurface Soil Sampling

Approximately 179 residential properties have been identified for sampling during this event. The actual number of residential properties sampled will depend on how many property owners grant access. Each residential property will have a minimum of five locations sampled. Vacant lots will also have 5 locations sampled.

The depth intervals (or portions of depth intervals) in yards previously sampled by the Illinois Environmental Protection Agency or previous contractors will not be resampled during this investigation. The unsampled intervals will be sampled to evaluate vertical extent of PAHs.

If refusal is encountered at a proposed boring location, a second boring will be attempted within two to five feet of the original assuming access and utility clearance allows. If refusal is also encountered at the second location, available depth intervals will be sampled if possible or the location will be excluded from the five-point composite sample. Boring and sampling locations will be selected in a consistent manner for each property layout and property as discussed below. A sketch of the property shall be included in the logbook to show the location of each soil boring used in the composite sample.

2.2.1 Standard Residential Lot Boring and Sample Locations

The sampling strategy for this "standard" residential lot type assumes a representative layout (front to back) consisting of a front yard adjacent to the residential street, house or apartment building, backyard, and a garage adjacent to an alley. This type of lot has the approximate dimensions of 125 feet by 25 feet and 3,000 sf or less of exposed soil areas. At this type of residential lot, borings at 1-2 locations in the front yard and 3-4 locations in the back yard will be advanced to collect soil samples. If a small side yard is present, it will be combined with the smaller of the front or back yard and sampled. Soil samples will be collected from unpaved, grassed, bare soil, landscaped, garden, overgrown, and unimproved areas of the property.

Surface soil samples will be collected from the 0 to 6 inch depth interval with shallow subsurface soil samples also collected from the 6 to 24 inch and 24 to 36 inch depth intervals. Sample aliquots from the boring locations in each yard will be combined to form the composite sample from each depth interval. A schematic soil sample layout for a typical residential property was provided in the work plan.

2.2.2 Vacant Residential Lots Sample Locations

Vacant lots are similar in size to a simple residential lot with approximate dimensions of 125 feet by 25 feet and 3,000 sf or less of exposed soil areas. Vacant residential lots will be sampled with five borings distributed across the entire lot with one composite sample collected from each depth interval. Boring locations will be evenly spaced across the lot area.

2.2.3 Multiple Residential Lot Sample Locations

The sampling strategy for this representative residential lot type assumes a layout consisting of a combination of two standard residential lots. This lot type will often consist of a

combination of a standard residential lot, as described above, and an adjacent additional plot of land which is typically grassed or landscaped. This type of lot will have the approximate dimensions of 125 feet by 50 feet and 3,000 sf or more of exposed soil areas.

The multiple residential lot will be sampled as two individual lots, with one composite sample from each depth interval obtained from the 1-2 locations in the front yard and 3-4 locations in the back yard of the occupied lot and one composite sample obtained from 5 borings drilled at the adjacent vacant lot. Gravel-covered areas within a residential lot should be sampled in the same manner as other areas. The gravel-size or larger sized fraction will be removed from the sample in the field. The remaining material will be collected and sampled.

2.2.4 Areas to Avoid Sample Collection

In an effort to minimize bias in the samples from other activities, areas to avoid sample collection include:

- Dripline from asphalt-shingled roofs of houses, garages or sheds (asphalt shingles are a source of PAHs)
- Runoff areas from downspouts or roofs
- Barbeque and fire pit areas
- Auto parking areas or storage areas for auto supplies, tires, waste oil, etc.
- Coal shoots, bins or heating oil pipes (PAHs are in coal and oils and may be present from drips, overflows, coal dust, etc.)
- Under concrete, paved or permanent structures,
- Localized impacted sources such as visually stained areas
- Areas with asphalt debris
- Within 2 feet of buildings or other structures, and
- Within 5 foot of sidewalks, driveways or other paved areas.

Grass and other vegetation are not to be sampled and should be removed from each sample.

2.2.5 Surface and Sub-Surface Soil Sample Collection Procedures

At each boring location, a soil sample will be collected from the following depth intervals:

- 0-6 inches below ground surface (bgs),
- 6-24 inches bgs, and
- 24-36 inches bgs.

The borings will be advanced using a stainless steel hand auger, power auger, or cart mounted Geoprobe unit. If an auger is used, it should not be advanced beyond each sampling interval without soil from that interval being collected. Care should be taken to avoid soil from overlying intervals from being included in deeper intervals. Soil from each discrete sampling interval per location will be placed in a stainless steel bowl or pan and covered with aluminum foil to prevent cross-contamination. In other words, there will be one stainless steel bowl for each discrete sample interval (for a total of four bowls per

property) into which soil from each sampling location will be placed. Equal amounts of soil from each depth interval and location will be added to each bowl. Each bowl will be assigned and labeled for a specific depth interval to avoid cross-contamination.

As the sampling equipment is advanced through the sample interval, soil will be placed within the stainless steel bowl to be composited. Soil from one location at a time will be collected at each property. Clean and decontaminated sampling equipment will be used at each sample location (decontamination procedures are provided below). Equal amounts of soil from each location will be added to the bowl to ensure the composite sample is equally weighted between all borings. Once soil from all locations and intervals have been collected, the soil in each bowl or pan will be homogenized (as described below) with a stainless steel spoon or spatula. Separate clean, decontaminated spoons or spatulas will be used for each bowl or pan. An aliquot of the composited soil sample will then be placed into the appropriate container(s) for independent laboratory analysis, labeled, and placed in an appropriate container for storage and shipment. The chain-of-custody form will then be completed for that sample.

It is extremely important that the soil samples be mixed thoroughly to ensure that the sample is as representative as possible of the sample media. A common method of mixing is referred to as quartering. The quartering procedure is performed as follows:

1. The material in the stainless steel bowl or pan is divided into quarters and each quarter is mixed individually,
2. Two quarters are then mixed to form halves,
3. The two halves are mixed to form a homogenous matrix.

This procedure is repeated several times until the sample is adequately mixed. If bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion, reversing direction, and occasionally turning the material over.

The prevention of cross-contamination of samples is crucial during the execution of the project. Cross-contamination is the introduction of contaminants into the sample through the sampling and/or sample-handling procedures. It can cause an otherwise representative sample to become non-representative. The most important means of minimizing cross-contamination are as follows:

- Sampling expendables such as gloves, towels, rinse waters, etc., must not be reused from one sampling location to the next. Used expendables should be labeled when feasible so they are not confused with non-contaminated trash.
- Minimum contact should be made between the sampler and the sample medium. For example, a sampler should not walk across a contaminated area and then take a surface soil sample where he or she just stepped. Sample collection activities should proceed progressively from the least contaminated areas to the most contaminated area (if known).
- Sampling equipment and containers should be constructed of Teflon, stainless steel, or glass that has been pre-cleaned for collecting samples. Any tools used in sampling must be carefully decontaminated prior to first use and after each sample.

- Activities that could contaminate samples are prohibited in the sample handling and preparation. Smoking should be avoided while sampling.
- Be aware of any other potential airborne sources of PAHs (e.g., vehicle or power auger exhaust, trash burning) that may potentially contaminate the soil samples being collected and try to sample upwind of such sources.

2.3 Lithologic Logging

The lithology, including any other foreign and exotic materials, encountered in each borehole will be logged. Information on the boring log sheet includes the borehole location, sampling information such as sampling intervals, and sample description information.

Lithologic descriptions of unconsolidated materials encountered in the boreholes will generally be described in accordance with the Unified Soil Classification System (USCS). Descriptive information to be recorded in the field will include:

- Identification of the predominant particles size and range of particle sizes,
- Percent of gravel, sand, fines, or all three,
- Description of grading and sorting of coarse particles,
- Particle angularity and shape (when discernible),
- Maximum particle size or dimension,
- Color using the Munsell Color System,
- Moisture content (dry, wet, moist),
- Consistency of fine grained soils,
- Structure of consolidated materials, and
- Cementation (weak, moderate, strong).

Any foreign materials will also be noted and described along with any odors that are detected.

2.4 Borehole Abandonment

At the completion of each boring location, the borehole will be backfilled with unused cuttings and topped off with extra topsoil as needed. The original sod plug will be placed on top of the boring. A photograph or videotape of the boring location will then be taken to document post-activity conditions.

2.5 Photo Documentation

Photographs (preferably in digital format) will be taken of pre- and post-sampling conditions at each property. The pictures should be formatted so that the date and time of each photo is recorded on the photograph. Entries into the daily logbook will include documentation of each photograph taken. A sign containing the address of the property, or some other means of property identification, should be apparent in the photographs. Any

other unusual attributes of the property that may affect data interpretation should also be taken along with a physical description of the object.

2.6 Decontamination Activities

Decontamination of field equipment is necessary to support the quality of samples by preventing cross contamination. Further, decontamination reduces health hazards and prevents the spread of contamination. All reusable equipment used to collect, handle, or measure samples will be decontaminated before coming into contact with any sample. Five gallon buckets, or other appropriate containers, will be used for decontamination of equipment. Decontamination water will be transferred into 55-gallon drums or other designated container at a location designated by FTL.

The following procedure will be used to decontaminate sampling devices:

- Scrub the equipment with a solution of potable water and Alconox or equivalent laboratory grade detergent,
- Rinse the equipment with potable water followed by analyte-free water. If the equipment has come in contact with visible oil or grease, rinse the equipment with pesticide-grade methanol followed by pesticide-grade hexane.
- Air dry the equipment on a clean surface or rack elevated above the ground.
- If the piece of equipment is not to be used immediately, wrap the device in oil-free aluminum foil for its next use.

2.7 Investigative Waste Handling and General Housekeeping

Waste may be classified as non-investigative waste or investigative/field-generated waste. Non-investigative waste, such as litter and household garbage, will be collected on an as-needed basis to maintain each property in a clean and orderly manner. This waste will be containerized and transported to a designated collection bin.

Investigative/field-generated waste (in this case decontamination water) will be containerized in U.S. Department of Transportation (DOT)-approved steel 55-gallon drums or other approved containers and stored at an approved/designated location. Each container will be properly labeled with site identification and matrix (decontamination fluids and associated solids). A record of each drum used during the investigation should be logged into the daily log book.

Properties should be kept tidy during sampling activities and, when practical upon departure, left with less trash than was present before initiation of sampling.

2.8 Sample Management Procedures

2.8.1 Sample Containers

The independent analytical laboratory will provide sample containers. The containers will be cleaned in accordance with USEPA protocol. All samples collected during the field investigation and submitted to laboratories for chemical analyses will be preserved according to USEPA standards. Ice-cooled chests will be utilized for the shipment of samples to the laboratory. Sample preservation requirements, holding times, and required sample container types are presented in the Quality Assurance Project Plan (QAPP).

2.8.2 Analytical Method

All soil samples will be analyzed for polycyclic aromatic hydrocarbons using the USEPA Test Methods for Evaluating Sold Waste, Physical/Chemical Methods, SW846, Method 8270C, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS). The specific compounds to be reported consist of:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenz(a,h) anthracene
- Indeno(1,2,3-cd)pyrene

The results will be evaluated through calculation of the benzo(a)pyrene equivalent concentration in accordance with USEPA-approved procedures.

2.8.3 Sample Identification

All samples and field quality control samples will be designated with unique sample identification (ID). The sample identification procedure will be implemented for the following types of environmental samples collected:

First Segment Of Sample Number	Second Segment Of Sample Number	Third Segment Of Sample Number	Fourth Segment Of Sample Number	Fifth Segment Of Sample Number	Sixth Segment Of Sample Number
Honeywell Location ID Number	Date	Sample Collection Team ID	Sample Number	Sample Depth	Sample Qualifiers
1234	051506 (For May 15, 2006)	02 (for Team 2)	01 (For First Sample Collected Today)	0624 (for 6 to 24 inches bgs)	MSD (for Matrix Spike Duplicate)

The following qualifiers will be added the end of the sample ID to signify the type of quality control sample:

D = Field Duplicate Sample
L = Location Duplicate
MS = Matrix Spike
MSD = Matrix Spike Duplicate
E = Equipment (Rinse) Blank
F = Field Blank

2.8.4 Sample Custody

The possession of samples must be traceable from the time the samples are collected until results are reported. To maintain and document sample possession, chain of custody (COC) procedures are followed as described below:

A sample is under your custody if:

- It is in your actual possession, or
- It is in your view, after being in your physical possession, or
- It was in your physical possession and then you locked it up to prevent tampering, or
- It is in a designated secure area.

The custody of samples is recorded in the following field documents:

- Sample logs
- Sample labels
- Custody seals, and
- COC form.

2.8.5 Sample Labels

Any samples placed into a sample container will be identified by a sample label. The following information is typically included on the labels:

- Project Number and Project Name,
- Date-Month, day, year,
- Time - Military time,
- Sample Identification,
- Sample Description,
- Sample - Sampler's name(s).

- Preservatives, and
- Analyses Requested.

The information described above should be printed neatly using an indelible marker. After the sample is taken and the label is securely attached, the sample is logged into the sample logbook. The sample label should be wrapped in clear plastic tape to prevent label deterioration and then placed into bubble wrap for container protection.

2.8.6 Custody Seals

Custody Seals are narrow strips of adhesive tape (ideally of glass fiber) used to demonstrate that no tampering of the sample shipment container (e.g., cooler) has occurred. They should be signed and dated by the sampler and placed across the openings of the sample transport containers (typically two seals, one placed in front of the cooler across the opening, another placed on the side of the opening). The seals are then taped with clear tape to prevent them from being inadvertently removed during shipment.

2.8.7 Chain-of-Custody Form

A COC form will be completed for each sampling event and will accompany the samples during shipment. The COC record documents the sample information and the transfer of custody from the sampler to the independent laboratory. The record will, at minimum, contain the following:

- Project Name,
- Project Location - city and state in which the project is located,
- Project Number,
- Project Contact - CH2M HILL employee responsible for overseeing the sampling operation. This person should be the individual to whom question are to be directed or verbal results given (Project Manager, Site Supervisor, Project QC Officer, or Project Chemist),
- Site Telephone Number - telephone number of onsite person (typically the field team leader),
- Sample Date - month, day, year,
- Sample Time - military time,
- Sample Identification - unique sample number/identifier,
- Sample Type - designation of sample as grab or composite,
- Sample Description - sample matrix and a brief description of the sampling location,
- Sample Preservation - preservative used (e.g., none, cool to 4°C, hydrochloric acid),
- Analytical Parameters Requested - analytical parameter, method numbers, and specific compounds of interest, if applicable,
- Airbill or courier tracking number, if necessary
- Laboratory - laboratory where samples are to be sent,
- Laboratory Phone - contact for laboratory,
- Laboratory Contact - contact for laboratory,
- Laboratory Purchase Order Number,
- Relinquished by - signature of sender,
- Date Relinquished - date samples were relinquished for shipping,

- Accepted By – signature of acceptor,
- Date Received – date samples were accepted,
- Turn-Around-Time (TAT) – TAT requested or date the results are required from the lab,
- Sampler's Signature,
- Signature of person(s) involved in chain-of-possession, and
- Transfer date(s) and time(s) in chain-of-possession.

Personnel preparing the chain-of-custody form will retain a copy of the form and attach it to the project's daily field logs.

If the samples are shipped by common carrier, the COC form will be placed in a sealed plastic bag inside the shipping container. Prior to shipment, the shipping container will be secured with tape (see below) and a custody seal. Thus, in case of using a common carrier for shipment, two signatures will be required on the final COC: one signature by the sample technician who prepared the form and one signature of the sample custodian assigned by the laboratory. The sample technician will relinquish the samples to the carrier. The carrier's company name and tacking number will be placed in the box of "receiver" and in the box of "relinquisher" upon being received at the laboratory by the sample custodian. The sample custodian must ensure that the tracking number on the sample container matches that on the COC. The sample custodian assigned by the laboratory will open the shipping container and will document on the COC form any shipping container custody seal breaks and/or shipping container or sample container(s) damage.

2.8.8 Sample Preservation, Packing, and Shipping

The samples collected during the field investigation will be handled to protect the samples from damage and to ensure sample delivery to the laboratory in sufficient time to preserve the analytical holding times. The empty sample containers should be kept in a cooler with ice to pre-chill the containers prior to sample collection. The sample bottles will be wrapped in protective covering (bubble wrap material) and enclosed in leak-proof sealable bags (e.g., ziplocks).

The cooler will contain additional packaging, as necessary, to protect the sample bottles from breakage. The cooler also will contain ice to maintain the samples at approximately 4° Celsius. The ice will be encased inside two leak-proof sealable bags to minimize leakage. The laboratory copies of the COC record will be placed inside a plastic bag affixed to the lid of the cooler. The cooler will be sealed for shipment using some form of shipping tape or duct tape. Custody seals will be affixed as previously described.

SECTION 3

Field Documentation

3.1 Responsibilities

Each sampling team will assign a single responsible party for field documentation. The party responsible for documentation will be focused on the field documentation effort such as the daily log and other related forms and will not be directly involved in the sample collection activities. The field documentation will include sufficient detailed information so that the history of each sample can be retained when necessary without the assistance of the sample collection personnel. Data will typically include a detailed description of equipment decontamination procedures, equipment calibration procedures, inventory of all generated wastes, and disposition of all generated wastes.

3.2 Daily Logbook

It is necessary for the sampling crew to maintain daily field notes. Logbooks are permanent records in project files. The purpose of a logbook is to document that the scope of work is being implemented in accordance with the approved work plans. Do not delay or procrastinate recording logbook information. It is not acceptable to wait until one is back in the hotel or office to write events and information down.

Label the logbook cover with the following information:

- Project name and number,
- Field team leader's last name,
- Date: Month/Year

On the inside cover, enter your name, office address, and phone number. Fill in the table of contents with the project identification number and page number.

Start the first page of each day as presented below:

- Date (e.g., Friday, March 03, 2006) and box it in,
- Start time - End Time
- Weather: AM, Noon, PM, and weather that occurred overnight if possible,
- Activities/objectives to be performed/reached that day,
- Personnel present and their affiliation,

Items that must be included are sampling protocol, any changes to the procedures, meetings, instructions, safety precautions, personnel protection, names and titles of visitors, and activities pertaining to the samples. The person taking notes must be knowledgeable enough about these activities to know which details are important. Do not skip lines.

Repetition of information recorded in other permanent logs should be avoided, but enough information should be recorded to present a clear and accurate picture of technical activities. At a later date, should a question arise concerning a specific event or a procedure used, it will be answered from these notes. The following information should be logged into the logbooks and/or database:

Sample number, locations, type, matrices, volumes, sample ID, and descriptions, type and number of sample containers, names and signatures of individuals performing sampling tasks, COC and airbill numbers, preservatives, and date samples were sent, and the following:

- A sketch of the property to show the location of each soil boring used in the composite sample.
- Name of laboratories and contacts to which the samples were sent, turnaround time (TAT) requested, and data results, when possible,
- Termination of a sample point or parameter and reasons,
- Unusual appearance or odor of a sample,
- Measurements, volume of flow, temperature, and weather conditions,
- Additional samples and reasons for obtaining them,
- Levels of protection used (with justification),
- Meetings and telephone conversations held,
- Details concerning any samples split with another party,
- Details of QC samples obtained,
- Sample collection equipment and containers, including their serial or lot numbers
- Field analytical equipment, and equipment utilized to make physical measurements will be identified,
- Calculation, results, and calibration data from field sampling, field analytical, and field physical measurement equipment (note source and ID, lot numbers of calibration gases),
- Property numbers of any sampling equipment used, if available,
- Property Address and short description (abandoned, occupied, multi-residential etc),
- Sampling station identification (box in station ID),
- Date and time of sample collection,
- Description of the sample location,
- Description of the sample,
- Who collected the sample,

- How the sample was collected (box in every sample collected),
- Diagrams/discussions of processes (e.g., decontamination procedures),
- Document tailgate health and safety discussion, Health and Safety Plan sign off by all those on site (and all visitors),
- Maps/sketches of sampling locations, and
- Weather conditions that may affect the sample (e.g., rain, extreme heat or cold, wind, etc.).

These notes must be dated and signed (each page) for validity. All logbooks will be bound and pre-numbered. All logbook entries will be made with indelible ink and legibly written. The language will be factual and objective. No erasures will be permitted. If an incorrect entry is made, the error will be crossed out with a single strike mark, initialed, and dated.

If audits are performed, the auditor's remarks and decisions must also appear in these notes. These audits should be followed up by written report submitted by the auditor, including opinions and conclusions. A copy of the report should be placed in the project file and one copy kept in the sampling file for easy reference.

APPENDIX B-2

Quality Assurance Project Plan

QUALITY ASSURANCE PROJECT PLAN

For the
Residential Study Area
Near the
Former Celotex Site
2800 South Sacramento Avenue
Chicago, Illinois 60623

Prepared for

Honeywell International Inc.

June 2006

Prepared by

CH2MHILL

QUALITY ASSURANCE PROJECT PLAN

RESIDENTIAL STUDY AREA NEAR THE FORMER CELOTEX SITE
Chicago, Illinois

Honeywell International Inc.

Prepared by: CH2M HILL

Date: June 2006

Approved by:

_____

USEPA, Region 5, Remedial Project Manager
Rosita Clarke-Moreno

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USEPA, Region 5, Quality Assurance Reviewer

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CH2M HILL Project Manager
Joel Wipf

_____

CH2M HILL Quality Assurance Manager

_____

Laboratory Operations Manager

_____

Quality Assurance Officer

Distribution List

Rosita Clarke-Moreno, USEPA, Region 5, Remedial Project Manager
USEPA, Region 5, Quality Assurance Reviewer
Joel Wipf, CH2M HILL Project Manager
CH2M HILL Quality Assurance Manager
Laboratory Operations Manager
Laboratory Quality Assurance Officer

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Acronyms and Abbreviations

B(a)P EQ	benzo(a)pyrene equivalents
C	Celsius
CCC	calibration check compounds
CCV	calibration check verification
CD-ROM	compact disk - read only memory
CLP	Contract Laboratory Program
COC	chain-of-custody
DFTPP	decafluorotriphenylphosphine
DMP	Data Management Plan
DMS	data management system
DQO	data quality objective
DVD	digital video disk
EB	equipment blank
EDD	electronic data deliverable
EICP	extracted ion current profile
FB	field blank
FSP	field sampling plan
FTL	field team leader
GC/MS	gas chromatography/mass spectrometry
ID	identification number
L	liter
LCL	lower control limit
LCS	laboratory control sample
LIMS	laboratory information management system
MDL	method detection limit
µg/L	micrograms per liter
mg/L	milligrams per liter
MS/MSD	matrix spike/matrix spike duplicate
PAH	polycyclic aromatic hydrocarbons
PPM	parts per million
QAM	quality assurance manager
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control

R	recovery
RL	reporting limits
RF	response factor
RPD	relative percent difference
RPM	Remedial Project Manager
RRF	relative response factor
RSD	relative standard deviation
SM	site manager
SOP	standard operating procedure
SPCC	system performance check compounds
UCL	upper control limit
USEPA	United States Environmental Protection Agency
VOA	volatile organic analysis

SECTION 1

Project Management

1.1 Introduction

The United States Environmental Protection Agency (USEPA) requires parties conducting environmental monitoring and measurement efforts mandated or supported by USEPA to participate in a centrally managed Quality Assurance Project Plan (QAPP). Parties generating data under this program must implement procedures so that the precision, accuracy, representativeness, completeness, and comparability of their data are known and documented. To meet this objective, a written QAPP must be prepared covering each project to be performed. All project participants, including subcontractors, must follow the procedures and protocols outlined in the QAPP.

This QAPP presents the organization, objectives, functional activities, and specific quality assurance (QA) and quality control (QC) activities for the residential soil sampling investigation near the former Celotex site in Chicago, Illinois.

This section provides an overall approach for managing the project that includes the following:

- Project organization, roles, and responsibilities
- Problem definition and background information
- Project description and schedule
- Data quality objectives (DQOs) and criteria for measurement data
- Instructions for special training requirements/certification
- Instructions for documentation and records management

1.2 Project Organization

CH2M HILL is responsible for all phases of the residential soil sampling investigation near the former Celotex site. The QA and management responsibilities of key project personnel are defined below and shown in Figure 1.

1.2.1 USEPA Region 5, Remedial Project Manager

The USEPA's remedial project manager (RPM) is responsible for the review of the project plans, including this QAPP, the project data, and results. Ms. Rosita Clarke-Moreno is the RPM for the former Celotex site in Chicago, Illinois.

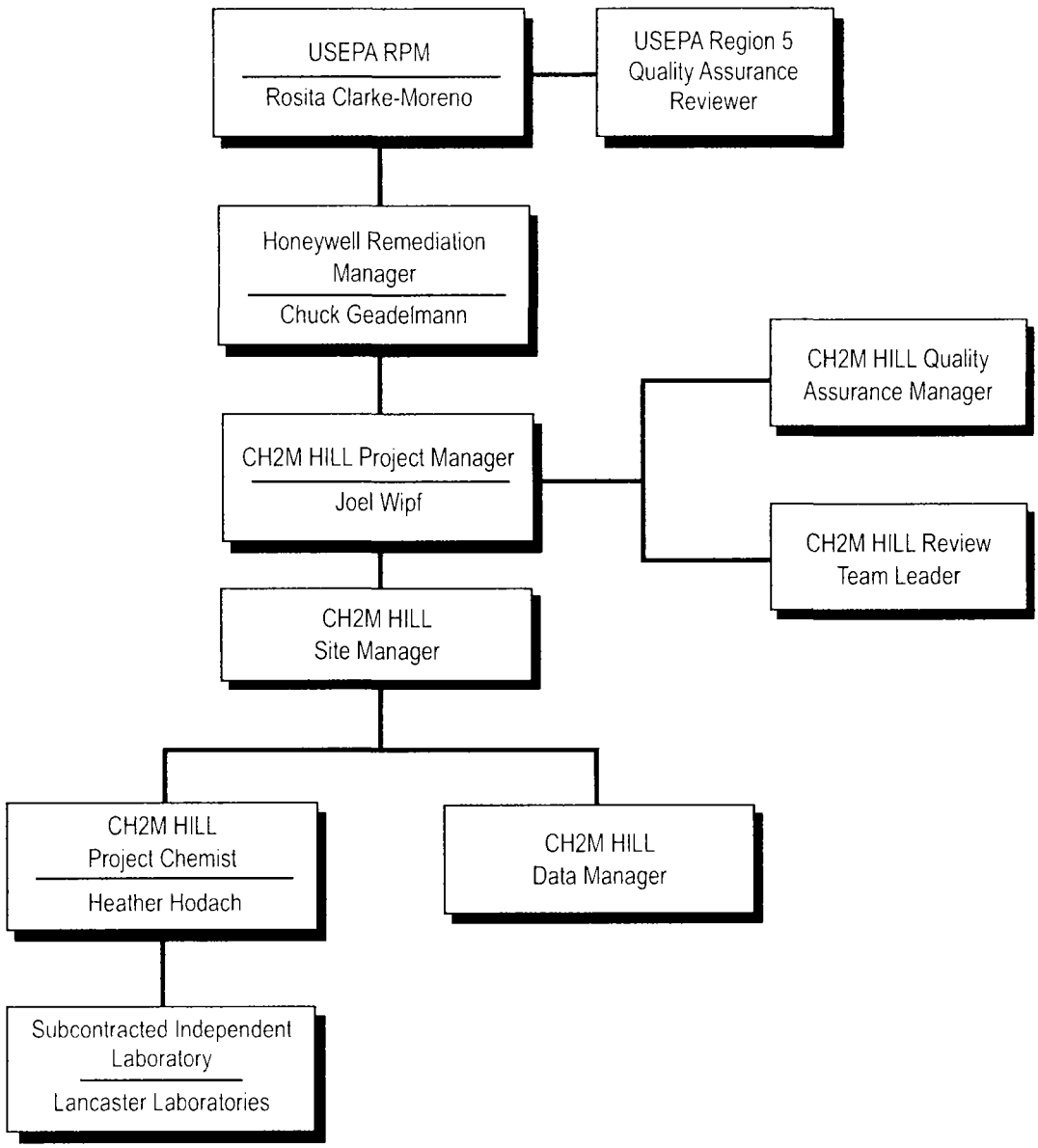

Figure 1
Project Organization Chart
Former Celotex Site
Chicago, Illinois

1.2.2 USEPA Region 5, Quality Assurance Reviewer

The USEPA representative is responsible for reviewing and approving this QAPP.

1.2.3 Honeywell Remediation Manager

Mr. Chuck Geadelmann is Honeywell's remediation manager.

1.2.4 CH2M HILL Project Manager

Joel Wipf, CH2M HILL's project manager, has overall responsibility for meeting Honeywell's objectives and CH2M HILL's quality standards, as well as technical QC and project oversight.

1.2.5 CH2M HILL Quality Assurance Manager

The quality assurance manager (QAM) will remain independent of direct job involvement and day-to-day operations, but has not been identified at this time. The QAM has the following responsibilities:

- Directing the QA review of the various phases of the project, as necessary
- Directing the review of QA plans and procedures
- Providing QA technical assistance to project staff, as necessary

The QAM also has direct access to management staff to resolve QA disputes, as necessary.

1.2.6 CH2M HILL Site Manager

The site manager (SM) is responsible for implementing the project and achieving the technical, financial, and scheduling objectives of the project. As such, the SM is authorized to commit the resources necessary to meet project objectives and requirements. The SM will report directly to the CH2M HILL Project Manager and will be the major point of contact for matters concerning the project. The SM has not been identified at this time. The SM has the following responsibilities:

- Defining project objectives and developing a detailed work plan and schedule
- Establishing project policy and procedures to address the specific needs of the project as a whole, as well as the particular objectives of each task
- Acquiring and applying technical and corporate resources to meet budget and schedule constraints
- Orienting field leaders and support staff to the project's special considerations
- Monitoring and directing other team members
- Developing and meeting ongoing project or task staffing requirements, including mechanisms for reviewing and evaluating each task product
- Reviewing the work performed on each task to ensure quality, responsiveness, and timeliness

- Reviewing and analyzing overall task performance with regard to the planned schedule and budget
- Representing the project team at meetings and public hearings

1.2.7 CH2M HILL Review Team Leader

The review team leader (RTL) supports the SM in site management activities and coordinates CH2M HILL internal reviews. The RTL has not been identified at this time. The RTL will be involved in ongoing planning work.

1.2.8 CH2M HILL Project Data Manager

CH2M HILL's project data manager is responsible for tracking data and overseeing the data base and data management functions. The data manager 's specific responsibilities include the following:

- Establishing the Data Management System (DMS)
- Overseeing the data management process including data conversion/manual entry
- Performing QC review of entered data
- Preparing required tables and specific queries/reports

1.2.9 CH2M HILL Project Chemist

Heather Hodach, CH2M HILL's project chemist, is responsible for tracking data and overseeing the data evaluation. Her specific responsibilities include the following:

- Scheduling the analytical laboratories
- Coordinating activities with laboratories and data validators
- Overseeing data validation and the production of results tables
- Ensuring the implementation and follow-up on corrective actions
- Evaluating data usability
- Overseeing the tracking of samples and data from the time of field collection until results are entered into the DMS

1.3 Problem Definition/Background Information

USEPA has defined the residential area requiring sampling as within the boundary set by Whipple Avenue, Sacramento Avenue, 28th Street, and 26th Street. In addition, Honeywell has voluntarily agreed to perform sampling within a larger area, although no connection has been made between these areas and the site to date. The residential properties proposed to be sampled within this work plan are bounded by 26th Street to the north, Kedzie Avenue to the west, 31st Street to the south, and Sacramento Avenue to the east. This area is referred to as the "residential study area."

Three residential sampling events were conducted between 1995 and 1999 under USEPA-approved work plans. Surface soil samples were collected from a subset of the residential properties surrounding the site during these events. The objectives were to obtain data to support risk assessment and background evaluations. Elevated levels of polycyclic aromatic hydrocarbons (PAHs) were documented within some of the residential soils. However, additional soil sampling is necessary to further define the area of impact in support of removal action planning.

Further detailed information is contained in Sections 1 and 2 of the Work Plan, including the site location map as Figure 1-1 and an aerial photograph as Figure 1-2. Work Plan Figures 1-1 and 1-2 are included as Appendix C of this QAPP.

1.4 Site History

The former Celotex site was used for making, storing, and selling asphalt roofing products. Former operations at the 24-acre main site during the approximate period of 1911 to 1989 resulted in the release of PAHs in the air. It is possible that PAH compounds may have migrated through airborne dispersion beyond the Celotex site boundaries and may be present in surface soils in some residential areas surrounding the site. Facility closure and demolition of the main site and subsequent actions have removed the previous source area such that no ongoing releases from the site exist.

The Celotex site formerly housed several manufacturing-related buildings including a large warehouse, smaller storage sheds, an enclosed tank area, and an office building. All buildings and former facility features have been demolished and a soil cover was placed subsequent to demolition. The main site is currently surrounded by a chain-link fence with a single entrance located at the main gate on Sacramento Avenue. In 2002, Sacramento Corporation bought the 22-acre portion of the Celotex property and placed approximately 2 feet of gravel on the main site for parking trucks.

1.5 Project Description and Schedule

1.5.1 Project Description

The objective of the residential soil sampling investigation is to further define the extent of PAH impacts within surface soil and shallow subsurface soil at residential properties surrounding the site, characterize residential properties on a lot-specific and depth-specific basis to support removal action planning based on benzo(a)pyrene (BAP) equivalent concentrations, and to assist in decision-making for the residential study area.

Previous investigations determined that PAH compounds are present. The analytical objectives of the proposed soil sampling are to collect data within the residential areas surrounding the site of sufficient quality for evaluation to support future decision-making and removal action planning.

1.5.2 Project Schedule

CH2M HILL has proposed to begin sampling on July 10, 2006. The sampling will take place during the work week (Monday to Friday) utilizing two field teams, with sampling scheduled to be completed by mid-August 2006. This will include collection of composite surface soil samples and subsurface soil samples. The analytical results will be provided on a 7-day turnaround basis with the data packages to be received in 21 days from time of sample receipt at the laboratory. Section 2 of this document describes the sampling analyses in detail. Appendix D contains the project schedule as described in the project Work Plan. (CH2M HILL, 2006)

1.6 Data Quality Objectives and Criteria for Measurement Data

1.6.1 Data Quality Objectives

DQOs are qualitative and quantitative statements that specify the quality of data required for supporting decisions made during or after site-related activities. Project-specific DQOs are developed using the seven step process presented below (DQOs presented in Table 1):

1. **State the problem.** Describe the problem to be studied concisely.
2. **Identify the decisions.** State the decisions to be made to solve the problem.
3. **Identify inputs to the decisions.** Identify information and supporting measurements needed to make the decisions and describe the source(s) of the information.
4. **Define the boundaries of the study.** Specify conditions (that is, time periods and spatial locations).
5. **Develop a decision rule.** Define the conditions by which a decision-maker will select alternatives, usually specified as "if/then" statements (for example, if average concentration in soil is less than cleanup level, then the site achieves remedial action goals).
6. **Specify tolerable limits on decision errors.** Define in statistical terms.
7. **Optimize the design for obtaining data.** Evaluate the results of the previous steps and develop the most resource-efficient design for data collection.

TABLE 1
Honeywell Celotex Data Quality Objectives
Honeywell Former Celotex Site, Chicago, Illinois

Task	Step 1: Statement of Problem	Step 2: Identify the Decision	Step 3: Inputs to Decisions	Step 4: Study Boundaries	Step 5: Decision Rules	Step 6: Limits of Decision Errors	Step 7: Optimize the Sampling Design
Residential Surface and Subsurface Soil Sampling	Data gathered from three phases of residential soil sampling in neighborhoods adjacent to the Celotex Facility has demonstrated the presence of PAHs. Human health risk assessments indicate that levels of some PAHs in the soil may pose an unacceptable risk to the public The USEPA has established a cleanup objective of 10 parts per million (ppm) B(a)P EQ While this level may not be the only criteria applied to guide remedial action planning, the additional sampling is intended to determine what the B(a)P EQ concentrations are in soil at each residential property within the study area to support remedial action planning.	Does the B(a)P EQ PAH concentration in soil exceed the cleanup objectives at residences that have been sampled? If so, where are these residences located and is soil to be removed at these locations?	Surface and shallow subsurface soil samples are to be collected from three depth intervals for each residence at five consistently chosen locations. Samples will be collected from 0-6 inches, 6-24 inches and 24-36 inches to evaluate vertical distribution. Soil from each discrete interval from each yard will be composited from which an aliquot of soil will be submitted for analysis The concentrations of PAHs will be determined from which the B(a)P EQ concentration will be calculated. The B(a)P EQ will be compared with cleanup objectives to determine the need for remedial actions	The residential study area is within the boundary set by 26th Street to the north, Kedzie Avenue to the west, 31st Street to the south, and Sacramento Avenue to the east. Soil samples will be collected from discrete intervals (see "Inputs to Decisions") and analyzed for the following PAHs: indeno(1,2,3-cd)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, benzo(a)pyrene, dibenz(a,h) anthracene, and benzo(a)anthracene Potential constraints or obstacles for implementing the SAP may include the following. • Unsafe conditions • Weather (lighting, snow, ice, extreme temperatures) • Access to properties	Two levels of decision rules will determine the need for further work. The first decision rule addresses the quality of the data used as input to the second decision rule. Individual analytical results will undergo an evaluation process to address usability. Precision, Accuracy, Representativeness, Completeness, and Comparability parameters will be assessed as they relate to QC Level III and Level IV data packages. If an unacceptable percentage of analytical results are deemed unusable or rejected resampling will be necessary. Data that are considered valid and usable will be used to determine a B(a)P EQ concentration for each discrete depth interval at each property sampled The decision rule to move forward and identify properties for remediation is currently being formulated among the stake holders (e.g., USEPA, the respondents)	Decision errors are those made when a site manager chooses the wrong response action, but would have chosen another response if given perfect data. Contributing to this error are sampling design errors and measurement errors. Sampling design errors will be minimized by implementing a standard design approach at each property. A standardized, biased sampling approach will be implemented where obtaining undisturbed soils from areas unaffected by obvious anthropogenic disturbances (surface spills, proximity to asphalt covers, coal bins, etc.) will be the goal. Spatial variability will be minimized by compositing samples over discrete depth intervals across the property. Measurement errors will be controlled by implementing rigorous laboratory quality control/quality assurance procedures that will be evaluated through strict adherence with this QAPP and established USEPA guidelines	Five samples per residential property were determined to be adequate to evaluate the depth-specific B(a)P EQ concentrations Sample design was adapted from the USEPA's "Superfund Lead-Contaminated Residential Sites Handbook," accounting for the smaller size, exposed soil area, and variability of the residential lots present

1.6.2 Measurement Performance Criteria

The measurement performance criteria will be checked on several levels using the following methods:

- Built-in QC standards
- Senior review
- Management controls

The measurement data must abide by specific QC standards. Data that do not meet these standards are qualified accordingly. The analytical data and the QC results will be checked by the bench chemist, the laboratory's QAM, and CH2M HILL's project chemist.

CH2M HILL staff members with relevant technical experience will review all documents that pertain to the project's quality standards. The field team leader (FTL) will supervise activities to assess whether field operating procedures are being followed during field sampling activities. Section 3 describes specific QC checks and corrective action measures.

1.7 Instructions for Special Training Requirements/Certification

As noted in Subsection 1.2, Project Organization, project team members with the necessary experience and technical skills were chosen to perform required project tasks.

The independent subcontractor selected to perform laboratory analyses will meet the project-specific requirements and USEPA specifications.

1.8 Instructions for Documentation and Records

1.8.1 Field Sampling Documentation

Field sampling activities will be recorded in field logbooks and property worksheets. Field logbook and property worksheet entries will include descriptions with as much detail as possible so that those going to the site do not have to recall a particular situation from memory. Modifications to field sampling protocols must be documented in the field logbook. The FTL is responsible for ensuring that modifications to sampling protocols are also documented.

The field logbooks to be used will be bound field survey books or notebooks. The property worksheets will be separate sheets to go out with the field crews, but will be copied and stored in a 3-ring binder in a secure location when not in use. Logbooks will be assigned to the field crew, but stored in a secure location when not in use. Project-specific document numbers will identify each logbook, the title page of which will contain the following information

- Name of the person to whom the logbook is assigned
- Logbook number
- Project name
- Project start date
- Project end date

At the beginning of each entry, the date, start time, weather, names of all sampling team members present, and the signature of the person making the entry will be documented. Measurements and samples collected will be recorded with a detailed description of the location of the station. The number of all photographs taken will also be noted. Equipment used to make measurements will be identified, along with the date of calibration.

The property worksheets will include the date, names of field crew members, address of the property, sample location name, and sample collection time. The bottom half of the property worksheet will have space to map the 5 point composite sample collection points in relation to property markers and for survey coordinates.

All entries will be made in ink with no erasures allowed. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed. Blank pages will be noted as being intentionally left blank.

Samples will be collected following the sampling procedures documented in the Field Sampling Plan (FSP). Sample collection equipment will be identified, along with the time of sampling, sample description, parameters being analyzed, and number of containers used. Unique sample identification numbers (IDs) will be assigned to each sample as described in the FSP. Field duplicate samples, which will receive a unique sample ID, will be noted in the field logbook.

Field personnel will provide comprehensive documentation of all aspects of field sampling, field analysis, and sample chain of custody (COC). This documentation constitutes a record that allows for the reconstruction of all field events to aid in the data review and interpretation process. All documents, records, and information relating to the performance of the field work will be retained in the project file.

1.8.2 Data Reporting

For the purposes of this investigation, two data reporting levels have been defined and summarized in Table 2:

- **Level 3 – Analytical Reporting**. Full contract laboratory program (CLP)-equivalent forms reporting is required for all non-field data.
- **Level 4 – Analytical Reporting**. Full CLP equivalent reporting, including all raw data, is required for 50 percent of all non-field data sent to the subcontracted laboratory.

TABLE 2
Data Package Deliverables
Honeywell Former Celotex Site, Chicago, Illinois

All Analytical Fractions	
Case Narrative—A detailed case narrative per analytical fraction is required and will include explanation of any non-compliance and/or exceptions and corrective action. Exceptions will be noted for receipt, holding times, methods, preparation, calibration, blanks, spikes, surrogates (if applicable), and sample exceptions.	•
Sample ID Cross Reference Sheet (Lab IDs and Client IDs)	•
Completed COC forms and any sample receipt information	•
Sample preparation logs (extraction/digestion)	•
Copies of non-conformance memos and corrective actions	•

Form [a]	Gas Chromatography/Mass Spectrometry (GC/MS) Organic Fractions	Level III	Level IV
1	Sample results	•	• + raw
2	Surrogate Recovery Summary (w/applicable control limits)	•	•
3	Matrix Spike (MS)/Matrix Spike Duplicate (MSD) Accuracy and Precision Summary[b]	•	• + raw
3	Laboratory Control Sample (LCS) Accuracy Summary	•	• + raw
4	Method Blank Summary	•	• + raw
5	Instrument Tuning Summary (including tuning summary for applicable initial calibrations)	•	•
6	Initial Calibration Summary (including concentration levels of standards)	•	• + raw
7	Continuing Calibration Summary	•	• + raw
8	Internal Standard Summary (including applicable initial calibrations)	•	•

[a] CLP form or summary form with equivalent information
[b] Relative percent difference (RPD) calculated according to method specifications (CLP using percent recovery, SW-846 using concentration)

1.8.2.1 Field Data Reporting

Information collected in the field through visual observation, manual measurement, and field instrumentation will be recorded in field notebooks and/or property worksheets and then entered into an electronic data log. The FTL or project chemist will review the data for adherence to this QAPP and consistency. Any concerns identified as a result of this review will be discussed with the QAM, corrected if possible, and incorporated into the data evaluation process.

Field data calculations, transfers, and interpretations will be conducted by the field crew and reviewed for accuracy by the FTL or project chemist. The appropriate task manager will review field documentation, data reduction, and accuracy of data entries into the data log. The data logs and documents will be checked for the following:

- General completeness
- Readability
- Use of appropriate procedures
- Modifications to sampling procedures are clearly stated
- Appropriate instrument calibration and maintenance records
- Reasonability of data collected
- Accuracy of sample locations
- Accuracy of reporting units, calculations, and interpretations

Where appropriate, field data forms and calculations will be processed and included as appendixes to the reports generated. Original field logs, documents, and data reductions will be kept in the project file.

1.8.2.2 Laboratory Data Reporting

Data reduction will be done manually or using appropriate application software. Quantitation procedures specified for each method must be followed. Calculations for analyses are based on regression analyses of calibration curves. Regression analysis is used to fit a curve through calibration standard data. Sample concentrations are calculated using the resulting regression equations. If data are reduced manually, the documentation must include the formulas used. Any application software used for data reduction must have been previously verified by the laboratory for accuracy. Documentation of the software's verification must be maintained on file in the laboratory. All documentation of data reduction must allow re-creation of the calculations.

Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be stored electronically and in hard copy format. Laboratory data entry will be sufficient to document the information used to arrive at reported values.

Electronic data storage will be used when possible. All electronic data shall be maintained in a manner that prevents inadvertent loss, corruption, and inappropriate alteration. Electronic data will be accessible and retrievable for a period of 10 years after project completion.

All data will undergo at least three levels of review at the laboratory before release. The analyst performing the tests initially will review 100 percent of the data. After the analyst's review has been completed, 100 percent of the data will be reviewed independently by a senior analyst or by the section supervisor for accuracy, compliance with calibration, and QC requirements, holding time compliance, and for completeness. Analyte identification and quantitation must be verified. Calibration and QC results will be compared with the applicable control limits. Reporting limits should be reviewed to make sure they meet the project objectives. Results of multiple dilutions should be reviewed for consistency. Any discrepancies must be resolved and corrected. Laboratory qualifiers will be applied when there are nonconformances that could potentially affect data usability. These qualifiers must be properly defined as part of the deliverables. All issues relevant to the quality of the data must be addressed in a case narrative. The laboratory QC manager will review at least 10 percent of data or deliverables generated for this program against the project-specific requirements. A final data review will then be conducted by the laboratory QAM for review and approval. The laboratory QAM will review the package, ensure that necessary corrections are made, and forward it to the laboratory project manager for review. A copy of the data package will be filed in the project file. Mailed data packages, along with applicable electronic data deliverables (EDDs), will be sealed in an appropriate shipping container with a custody seal and logged on a document mailing log.

Deviations from stated guidelines must be addressed through corrective action. Deviations caused by factors outside the laboratory's control, such as matrix interference, will be noted with an explanation in the report narrative. The laboratory will contact the project chemist to discuss any deviations before the final data are sent out. Calculations will be checked and reports reviewed for errors, oversights, or omissions. The hard copy and electronic laboratory reports for all samples and analyses will contain the information necessary to perform data evaluation.

1.8.3 Electronic Analytical Record Format

The laboratory will provide EDDs for each batch or sample delivery group following Honeywell's required EDD specifications and guidance. These specifications are included in the Data Management Plan (DMP) and given to the laboratory in the laboratory contract or statement of work.

1.8.4 Project Record Maintenance and Storage

Project records will be stored and maintained in accordance with CH2M HILL's DMP and Subsection 2.9 of this QAPP. Each project team member is responsible for filing all project information or providing it to the project assistant familiar with the project filing system. Individual team members may maintain separate files or notebooks for individual tasks, but must provide such materials to the project file room upon completion of each task.

The general project file categories are as follows:

- Correspondence
- Nonlaboratory project invoices and approvals by vendor
- Original unbound reports
- Nonlaboratory requests for proposals (solicitations), bids, contracts, and statements of work
- Field data
- Data evaluation and calculations
- Site reports from others
- Photographs
- Insurance documentation
- Laboratory analytical data and associated documents/memos
- Regulatory submittals, licensing, and permitting applications
- Site and reference material
- Health and safety plans
- Figures and drawings

A project-specific index of file contents must be kept with the project files at all times.

SECTION 2

Data Generation and Acquisition

This section describes the procedures for acquiring, collecting, handling, measuring, and managing data in support of this sampling activity. It addresses the following data generation and acquisition aspects:

- Sampling process design
- Sample handling and custody requirements
- Sampling method requirements
- Laboratory analytical method requirements
- Laboratory QC requirements
- Field and laboratory instrument calibration and frequency
- Inspection and acceptance requirements for supplies and consumables
- Data acquisition requirements
- Data management
- Field and laboratory instrument and equipment testing, inspection, and maintenance requirements

2.1 Sampling Process Design

2.1.1 Soil Sampling Summary

The sampling locations best fulfill the project objectives stated in Step 2 of the DQO process. The sampling design consists of surface and shallow subsurface soil sampling. For more information on proposed sample locations and quantities, refer to Section 2.2 in the FSP. Table 3 of this QAPP summarizes the number of field and QC samples to be collected. Sampling will be performed according to the methods identified in Section 2.2.6 of the FSP.

TABLE 3
Soil Samples
Honeywell Former Celotex Site, Chicago, Illinois

Parameter	Analytical Method	Field Samples	Field Duplicates	MS/MSD[a] Samples	Field Blank (FB)[b]	Equipment Blank (EB)[b]	Total Samples
PAHs	SW-846 8270C	1.011	102	51/ 51	4	7	1.229

[a]MS/MSD – Individual sample numbers listed, not MS/MSD set.
[b]FBs and EBs are aqueous matrices.

2.1.2 Sampling Method Requirements

Section 2.2.6 of the FSP describes the field sampling method and Section 2.6 describes the decontamination procedures. Before sampling at a property, reusable (nondedicated) sampling equipment will be scrubbed with an Alconox and potable water solution, rinsed with potable water and then with analyte-free water, and air dried. Equipment blanks (EBs) will be collected by passing laboratory de-ionized water over decontaminated sampling equipment. The EBs will be analyzed for the same parameters as the field samples to assess the effectiveness of the decontamination procedures.

2.2 Sample Handling and Custody Requirements

2.2.1 Sample Handling and Preservation

Table 4 summarizes the sample preservation and holding requirements.

TABLE 4
Required Analytical Method, Sample Containers, Preservation, and Holding Times
Honeywell Former Celotex Site, Chicago, Illinois

Analyses	Preparatory / Analytical Method	Sample Matrix[a]	Container[b]	Qty	Preservative[c]	Holding Time[d]
PAHs	SW-846 3510C/8270C	W	1-L amber glass	2	Cool to 4°C	7/40 days[e]
	SW-846 3550B/8270C	S	8 ounce glass	1	Cool to 4°C	14/40 days[f]

Notes:
Sample containers and volume requirements will be specified by the independent analytical laboratory performing the tests.
[a] S = surface soil, subsurface soil; W = water
[b] All containers will be sealed with Teflon®-lined screw caps.
[c] All samples will be stored promptly at 4°C in an insulated chest.
[d] Holding times are from the time of sample collection.
[e] 7 days to extraction for water, 40 days for analysis.
[f] 14 days to extraction for soil, 40 days for analysis.

Corrective action will be initiated when a target analyte that exceeds the reporting limit is detected in an equipment blank. Such actions may include discontinuing the use of a specific bottle lot, contacting the bottle suppliers for retesting the representative bottle from a suspect lot, resampling suspect samples, validating the data (accounting for contaminants possibly introduced by the laboratory as a bottle QC problem [e.g., common laboratory solvents, sample handling artifacts]), and determining whether the bottles and data are usable.

2.2.2 Sample Identification System

CH2M HILL has devised a sample numbering system that will be used to identify each sample, including duplicates and blanks. Detailed sample numbering information is located in Section 2.8.3, Sample Identification, of the FSP.

2.2.3 Sample Packaging and Shipment

Sample handling, packaging and shipping procedures are described in Section 2.8.8, Sample Handling, Packaging, and Shipping, of the FSP.

Sample coolers will be shipped to arrive at the laboratory the morning after sampling (priority overnight) or will be sent by a courier to arrive the same day. The laboratory will be notified of the sample shipment and the estimated date of arrival of the samples being delivered.

If samples are shipped, airbills will be retained to provide a record for sample shipment to the laboratory. Completed airbills will accompany shipped samples to the laboratory and forwarded along with data packages. The airbill number will be documented on the COC form accompanying the samples to the laboratory for sample-tracking purposes. Airbills will be kept as part of the data packages in the project files.

2.2.4 Sample Custody

Accurate records, control of samples, and data custody are necessary to provide relevant and defensible data. Data custody is addressed during field sample collection, data analyses in the laboratory, and through proper handling of project files. Persons will be considered to have custody of samples when samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured to prevent tampering. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel. Section 2.8 of the FSP further discusses sample custody in the field.

COC forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. Field personnel designated as responsible for sample custody will fill out COC forms at each sampling site, at a group of sampling sites, or at the end of each day of sampling. Original COC forms will accompany samples to the laboratory, and copies will be forwarded to the project files. A sample COC is provided in Appendix B.

2.2.4.1 Field Custody Procedures

COC forms will be required for all samples. The sampling crew in the field will initiate COC forms. COC forms will contain the sample's unique ID, sample date and time, sample description, sample type, preservation (if any), and analyses required. Original COC forms, signed by the sampling crew, will accompany the samples to the laboratory. A copy of relinquished COC forms will be retained with the field documentation. COC forms will remain with the samples at all times. Samples and signed COC forms will remain in the sampling crew's possession until samples are delivered to the express carrier (Federal Express), courier, hand-delivered to the laboratory, or placed in secure storage.

2.2.4.2 Laboratory Custody Procedures

Laboratory custody procedures will be in place to ensure the integrity of sample and laboratory data handling. Subcontracted laboratory custody procedures are defined in the laboratory's COC SOP in Appendix A.

2.2.4.3 Laboratory Sample Receipt

Upon sample receipt, the laboratory sample custodian will open the coolers, check temperature blanks (and record temperatures), verify sample integrity, and inspect contents against the COC. The laboratory project manager will be contacted to resolve any discrepancies between sample containers and COC forms. Once the shipment and COC form are in agreement, the sample custodian will initiate an internal COC form as well as supply the laboratory task manager with a sample acknowledgement letter or e-mail. Verification of the cooler temperature and sample preservation will be performed and documented. If the cooler temperature is outside of criteria (4+/-2°C) upon receipt, or any other discrepancies are identified, the laboratory will contact the project chemist, who will determine the proper course of action.

Samples will be logged into the Laboratory Information Management System (LIMS), which assigns a unique laboratory number to each sample. LIMS will be used by all laboratory personnel handling samples, to ensure all sample information is captured. Analyses required will be specified by codes assigned to samples at log in. Labels containing the laboratory sample number are generated and placed on sample bottles.

2.2.4.4 Laboratory Sample Storage

After the laboratory labels the samples, they will be moved to refrigerators where they will be maintained at 4°C. Access to the laboratory is limited by either locked doors or front desk sign in.

When samples are required, laboratory staff will sign and date the appropriate internal COC forms. If entire samples are depleted during analysis, the notation "sample depleted" or "entire sample used" will be made on the internal COC forms.

Sample extracts will be stored in designated secure, refrigerated storage areas. Samples and sample extracts will be maintained in secure storage until disposal. No samples or extracts will be disposed of without prior written approval from an appropriate member of the project team. The sample custodian will note sample disposal date in the sample ledger. The laboratory will dispose of samples in accordance with applicable regulations.

2.2.4.5 Laboratory Logbooks

Workbooks, bench sheets, instrument logbooks, and instrument printouts will be used to trace the history of samples through the analytical process and document important aspects of the work, including associated QC. As such, all logbooks, bench sheets, instrument logs, and instrument printouts will be part of the laboratory's permanent record. Relevant information will be entered into the LIMS at the time information is generated.

Each page or entry will be dated and initialed by the analyst at the time of entry. Entry errors will be crossed out in indelible ink with a single stroke, corrected without obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Unused pages of logbooks will be completed by lining out unused portions that are then initialed.

The analyst will record information regarding the sample, the analytical procedures performed, and the results on laboratory forms and enter this information in LIMS. These notes will be dated and identify the analyst, instruments used, and instrument conditions.

Sufficient raw data records must be retained to permit reconstruction of initial instrument calibrations: calibration date, test method, instrument, analysis date, each analyte name, concentrations and responses, calibration curves, response factors, or unique equations or coefficients used to reduce instrument responses into concentrations.

From time to time, the laboratory group leaders will review laboratory notebooks for accuracy, completeness, and compliance with this QAPP. The laboratory group leader will verify all entries and calculations. If all entries on the pages are correct, the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs.

2.2.4.6 Laboratory Project File

Documentation will be placed in a single, secured project file, maintained by the laboratory project manager. This file will consist of these components, all filed chronologically:

- Agreements
- Correspondence
- Memorandums
- Notes and data

Reports (including QA reports) will be filed with correspondence. Analytical laboratory documentation and field data will be filed with notes and data. Filed materials may only be removed by authorized personnel on a temporary basis. The name of the person removing the file will be recorded. Laboratories will retain project files and data packages for at least 7 years unless otherwise specified.

2.2.4.7 Computer Tape and Hard Copy Storage

All electronic files will be maintained on CD-ROM or DVD (preferred media types), magnetic tape, or diskette for 10 years. Hard copy data packages (including chromatograms) will be maintained in files for 7 years. The computer tape and hard copy storage should include notation of instrument run files and calibration.

2.3 Analytical Method Requirements

Once the samples have been properly collected and documented, the soil samples will be submitted to the selected independent laboratory subcontracted by CH2M HILL for analysis. Samples will be analyzed in accordance with this QAPP and the specified USEPA method.

2.3.1 Target Analytes and Reporting Limits

Tables 5-A and 5-B specify the target analytes, the required reporting limit, and achievable laboratory detection limits by method and matrix. The project action limits are as stated in

Table 1, Step 1: "The USEPA has set a cleanup objective of background (which is equal to 5 parts per million (ppm) B(a)P EQ." The B(a)P EQ concentration is the sum of the concentrations of seven PAH compounds, after each concentration is multiplied by that compounds relative potency (as compared to benzo(a)pyrene), as shown in Table 5-C. Compounds that are non-detect will be utilized in the calculation through use of half the method detection limit. Estimated values (J qualified) will be used as the reported value. All samples must be analyzed undiluted or at the lowest possible dilution level. The laboratory will contact the project chemist when dilutions are required due to matrix interference. When a target analyte's concentration exceeds the calibration range, a dilution analysis will be performed to accurately determine the analyte's concentration. The laboratory will report the undiluted/lowest dilution performed and any diluted analyses that are required.

TABLE 5-A
Water Analytes and Reporting Limits
Honeywell Former Celotex Site, Chicago, Illinois

Parameter	CAS Number	Project Reporting Limit (µg/L)	Achievable Lab MDLs (µg/L)	Project Method
Benzo(a)anthracene	56-55-3	10	1	SW-846 3510C/8270C
Benzo(a)pyrene	50-32-8	10	1	SW-846 3510C/8270C
Benzo(b)fluoranthene	205-99-2	10	1	SW-846 3510C/8270C
Benzo(k)fluoranthene	207-08-9	10	1	SW-846 3510C/8270C
Chrysene	218-01-9	10	1	SW-846 3510C/8270C
Dibenz(a,h)anthracene	53-70-3	10	1	SW-846 3510C/8270C
Indeno(1,2,3-cd)pyrene	193-39-5	10	1	SW-846 3510C/8270C

µ/L = micrograms per liter
MDL = Method Detection Limit

TABLE 5-B
Soil Analytes and Reporting Limits
Honeywell Former Celotex Site, Chicago, Illinois

Parameter	CAS Number	Project Reporting Limit (µg/kg)	Achievable Lab MDLs (µg/kg)	Project Method
Benzo(a)anthracene	56-55-3	330	33	SW-846 3550B/8270C
Benzo(a)pyrene	50-32-8	90	33	SW-846 3550B/8270C
Benzo(b)fluoranthene	205-99-2	330	33	SW-846 3550B/8270C
Benzo(k)fluoranthene	207-08-9	330	33	SW-846 3550B/8270C
Chrysene	218-01-9	330	33	SW-846 3550B/8270C
Dibenz(a,h)anthracene	53-70-3	90	33	SW-846 3550B/8270C
Indeno(1,2,3-cd)pyrene	193-39-5	330	33	SW-846 3550B/8270C

µg/kg = micrograms per kilogram
MDL = Method Detection Limit

TABLE 5-C
Individual PAH Potency Relative to Benzo(a)pyrene Assuming Equal Concentrations
Honeywell Former Celotex Site, Chicago, Illinois

Compound	Relative Potency
Benzo(a)anthracene	0.1
Benzo(a)pyrene	1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenz(a,h)anthracene	1
Indeno(1,2,3-cd)pyrene	0.1

2.3.2 Analytical Standard Operating Procedures

The laboratory uses analytical SOPs to ensure that the samples submitted are accurately and precisely analyzed. The laboratory will follow their analytical SOP or the USEPA method guidance when this QAPP does not specify QC criteria. If not otherwise stated within this QAPP, the QC criteria used during the analyses are those stated within the analytical SOPs (Appendix A).

2.4 Quality Control Requirements

The analytical laboratory shall have a QC program to assess the reliability and validity of the analyses being performed. The purpose and creation of QC samples is discussed and summarized below. Laboratory quality control checks indicate the state of control that prevailed at the time of sample analysis. Quality control checks that involve field samples, such as matrix, surrogate spikes, and field duplicates, also indicate the presence of matrix effects. Field-originated blanks provide a way to monitor for potential contamination to which field samples are subjected. This QAPP specifies requirements for method blanks, laboratory control samples (LCSs), surrogate spikes, and MS/MSDs that laboratories participating in the data collection effort must follow.

A laboratory quality control batch is defined as a method blank, LCS, MS/MSD, or a sample duplicate, depending on the method and 20 or fewer environmental samples of similar matrix that are extracted or analyzed together. For gas chromatography/mass spectrometry (GC/MS) volatile analyses, a method blank, LCS, and MS/MSD must be analyzed in each 12-hour time period. The number of environmental samples allowed in the laboratory quality control batch is defined by the remaining time in the method-prescribed 12-hour time period divided by the analytical run time. Each preparation or analytical batch will be identified in such a way as to be able to associate environmental samples with the appropriate laboratory QC samples.

2.4.1 Quality Control Samples

2.4.1.1 Quality Control Analyses/Parameters Originated by the Laboratory

Method Blank. Blanks are used to monitor each preparation or analytical batch for interference and/or contamination from glassware, reagents, and other potential sources within the laboratory. A method blank is an analyte-free matrix (laboratory reagent water for aqueous samples or Ottawa sand, sodium sulfate, or glass beads (metals) for soil samples) to which all reagents are added in the same amount or proportions as are added to the samples. It is processed through the entire sample preparation and analytical procedures along with the samples in the batch. There will be at least one method blank per preparation or analytical batch. If a target analyte is found at a concentration that exceeds the reporting limit, corrective action must be performed to identify and eliminate the contamination source. All associated samples must be re-prepared and reanalyzed after the contamination source has been eliminated. No analytical data may be corrected for the concentration found in the blank.

Laboratory Control Sample. The LCS will consist of an analyte-free matrix such as laboratory reagent water for aqueous samples or Ottawa sand, sodium sulfate, or glass beads (metals) for soil samples spiked with known amounts of analytes that come from a source different than that used for calibration standards. Target analytes specified in the QAPP will be spiked into the LCS. The spike levels will be less than or equal to the mid-point of the calibration range. If LCS results are outside the specified control limits, corrective a ction must be taken, including sample re-preparation and reanalysis, if appropriate. If more than one LCS is analyzed in a preparation or analytical batch, the results of all LCSs must be reported. Any LCS recovery outside quality control limits affects the accuracy for the entire batch and requires corrective action.

Matrix Spike/Matrix Spike Duplicate. A sample matrix fortified with known quantities of specific compounds is called a matrix spike. It is subjected to the same preparation and analytical procedures as the native sample. For this project, all target analytes specified in the QAPP will be spiked into the sample. Matrix spike recoveries are used to evaluate the effect of the sample matrix on the recovery of the analytes of interest. An MSD is a second fortified sample matrix. The relative percent difference (RPD) between the results of the duplicate matrix spikes measures the precision of sample results. Only project-specific samples designated on the COC form will be spiked. The spike levels will be less than or equal to the mid-point of the calibration range. MS/MSD pairs will be analyzed at a frequency of one pair for every 20 samples. The QA/QC precision and accuracy criteria are those stated in Table 6.

2.4.1.2 Quality Control Analyses Originated by the Field Team

Field QC samples will be collected to determine the accuracy and precision of the analytical results. The QC sample frequencies are stated below. Sampling activities will be conducted in accordance with the Health and Safety Plan and all sample-handling procedures will be in accordance with this QAPP. Table 4 summarizes sample containers, holding times, and preservation requirements.

Equipment Blank. EBs will be collected to monitor cleanliness of sampling equipment and the effectiveness of decontamination procedures. Contamination from the sampling equipment can cause high analytical results or lead to reporting false positive results. EBs will be prepared by filling sample containers with laboratory-grade analyte-free water that has been passed through a decontaminated or unused disposable sampling device. The required QC limits for EB concentrations are to be less than the method's reporting limit. EBs will be collected at a frequency of one per week. Samples associated with EBs that have detected target analytes will be assessed. The usability of the associated analytical data will be documented and affected data will be appropriately qualified.

Field Duplicate. Field duplicates are collected in the field from a single aliquot of sample to determine the precision and accuracy of the field team's sampling procedures. Field duplicates will be collected and analyzed at a frequency of one duplicate for every 10 samples. The precision criteria for the duplicate samples will be ± 35 percent in soil samples.

Laboratory QC requirements are provided in Table 6.

TABLE 6
Accuracy and Precision Limits for PAHs
Honeywell Former Celotex Site, Chicago, Illinois

Analyte	LCS Accuracy Water (% R)	MS/MSD Accuracy Water (% R)	Precision Water (% RPD)	LCS Accuracy Sediment (% R)	MS/MSD Accuracy Sediment (% R)	Precision Sediment (% RPD)
Benzo(a)anthracene	72-112	72-112	30	73-111	42-137	30
Benzo(a)pyrene	68-121	70-115	30	72-117	38-142	30
Benzo(b)fluoranthene	67-117	69-114	30	68-116	42-141	30
Benzo(k)fluoranthene	67-120	68-117	30	71-116	36-143	30
Chrysene	70-111	71-111	30	72-110	39-140	30
Dibenzo(a,h)anthracene	71-129	73-126	30	70-130	35-157	30
Indeno(1,2,3-cd)pyrene	67-122	69-118	30	66-123	32-146	30
Surrogates						
2-Fluorobiphenyl	64-112			55-123		
Nitrobenzene-d5	51-123			47-128		
Terphenyl-d14	52-151			51-158		

LCS = Laboratory control sample
MS = Matrix spike
MSD = Matrix spike duplicate
R = Recovery
RPD = Relative percent difference

2.4.2 Data Precision, Accuracy, and Completeness

Field QA/QC samples and laboratory internal QA/QC samples are collected and analyzed to assess the data's usability. Analytical SOPs and Table 6 specify acceptance criteria for precision and accuracy requirements for these QC samples. The QA/QC criteria for the internal laboratory QC samples that are not referenced in the appropriate analytical SOPs shall be those stated in the referenced methods. Completeness is the percentage of usable data obtained during the sampling event and its acceptance criteria is project specific.

2.4.2.1 Precision

The precision of laboratory analysis will be assessed by comparing the analytical results between MS/MSDs. The precision of the field sampling procedures will be assessed by reviewing field duplicate sample results. The RPD will be calculated for the duplicate samples using the equation

$$\%RPD = \{(S - D)/[(S + D)/2]\} \times 100$$

where: S = First sample value (original value)
D = Second sample value (duplicate value)

The precision criteria for the duplicate samples will be ± 35 percent in soil samples. Sample results will be qualified "J" as estimated in quantity when this QC limit is exceeded. The acceptable MS/MSD precision criteria are stated in Table 6 if they are more stringent than the analytical SOPs.

2.4.2.2 Accuracy

Accuracy of laboratory results will be assessed for compliance with the established QC criteria using the analytical results of method blanks, reagent/preparation blanks, and MS/MSD samples. Laboratory results accuracy will be assessed for compliance with the established QC criteria described in the analytical SOPs. The percent recovery (%R) of laboratory control samples will be calculated using the equation

$$\%R = (A/B) \times 100$$

where:

A = The analyte concentration determined experimentally from the laboratory control sample

B = The known amount of concentration in the sample

The accuracy criteria for the QA/QC samples are those stated in Table 6 if they are more stringent than the analytical SOPs.

2.4.2.3 Completeness

The data completeness of laboratory analyses results will be assessed for compliance with the amount of data required for decision making. Complete data are data that are not rejected. Data qualified with qualifiers such as a "J" or a "UJ" are still deemed acceptable

and can still be used for making project decisions. The completeness of the analytical data is calculated using the equation

$$\% \text{ Completeness} = [(\text{Valid data obtained})/(\text{Total data planned})] \times 100$$

The percent completeness goal for this sampling event is 90 percent.

2.4.2.4 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability and the variability of environmental media at the site. Representativeness is a qualitative "measure" of data quality.

The goal of achieving representative data in the field starts with a properly designed and executed sampling program that carefully considers the project's overall DQOs. Proper location controls and sample handling are critical to obtaining representative samples.

The goal of achieving representative data in the laboratory is measured by assessing accuracy and precision. The laboratory will provide representative data when all of the analytical systems are in control. Therefore, representativeness is a redundant DQO for laboratory systems if proper analytical procedures are followed and holding times are met.

In addition, laboratories must demonstrate that the staff is qualified to perform the analyses, certified, and proficient in the analytical methods being employed.

2.4.2.5 Comparability

Comparability is the degree of confidence to which one data set can be compared to another. Comparability is a qualitative "measure" of data quality.

The goal of achieving comparable data in the field starts with a properly designed and executed sampling program that has the project's overall DQOs carefully integrated. Proper location controls and sample handling are critical to obtaining comparable samples.

The goal of achieving comparable data in the laboratory is measured by assessing accuracy and precision. The laboratory will provide comparable data when all of the analytical systems are in control. Therefore, comparability is a redundant DQO for laboratory systems if proper analytical procedures are followed and holding times are met.

2.4.2.6 Sensitivity

Sensitivity is the ability of the method or instrument to detect the contaminant of concern and other target compounds at the level of interest. Appropriate sampling and analytical methods will be selected (Tables 1 and 2) that have QC acceptance limits that support the achievement of established performance criteria (see Table 5 for Reporting Limit Objectives). Assessment of analytical sensitivity will require thorough data validation. Soil samples do not require stabilization of any kind before sampling.

2.5 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

2.5.1 Field Instrument Maintenance

There will not be any field instruments used that requires maintenance.

2.5.2 Laboratory Equipment/Instruments

Only qualified personnel will service instruments and equipment. Repairs, adjustments, and calibrations will be documented in the appropriate logbook or data sheet.

2.5.2.1 Instrument Maintenance

Preventive maintenance of laboratory equipment will follow guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired by in-house staff or through a service call to the manufacturer.

The laboratory will maintain a sufficient supply of spare parts for its instruments to minimize downtime. Whenever possible, backup instrumentation will be on hand.

Whenever practical, analytical equipment should be maintained under a service contract. Such contracts allow for preventative system maintenance and repair on an "as-needed" basis. The laboratory should have sufficiently trained staff to allow for the day-to-day maintenance of equipment. All laboratory instruments will be maintained in accordance with manufacturer's specifications and within the requirements of the laboratory Quality Assurance Manual.

All maintenance must be documented in the logbooks.

2.5.2.2 Equipment Monitoring

Operation of balances, ovens, refrigerators, and water purification systems will be checked daily and documented. Discrepancies will be reported immediately to the appropriate laboratory personnel for resolution.

Specific laboratory preventative maintenance procedures are found in the laboratory's internal laboratory Quality Assurance Manual.

2.6 Instrument Calibration and Frequency

2.6.1 Laboratory Instruments

Laboratory instruments will be calibrated by qualified personnel before sample analysis, according to the procedures specified in each method, analytical SOPs, and as noted below. Calibration will be verified at method-specified intervals throughout the analysis sequence. The frequency and acceptance criteria for calibration are specified for each analytical method, with supplemental requirements defined below for organic methodologies. When multi-point calibration is specified, the concentrations of the calibration standards should

bracket those expected in the samples. Samples will be diluted, if necessary, to bring analyte responses to within the calibration range. Data that exceed the calibration range cannot be reported by the laboratory. The initial calibration curve will be verified as accurate with a standard purchased or prepared from an independent second source. The initial calibration verification involves the analysis of a standard containing all the target analytes, typically in the middle of the calibration range, each time the initial calibration is performed. Quantitation based on extrapolation is not desirable. Designated laboratory personnel performing QC activities will maintain and file records of calibration, repairs, or replacement. These records will be filed where the work is performed and subject to a QA audit.

Standards used in equipment must be traceable, directly or indirectly, to the National Institute of Standards and Technology. All standards received will be logged into standard receipt logs maintained by the individual analytical groups. Each group maintains a standards log that tracks the preparation of standards used for calibration and QC purposes.

2.6.1.1 Initial Calibration Models for the Determination of Organic Compounds

Organic methodologies often provide multiple options for initial calibration curve fits and associated acceptance criteria for use. The following sections outline required "good laboratory practices" that will be employed by the laboratory. The hierarchy that the laboratory will use when selecting the calibration curve fit for use in quantitation of sample results is outlined below.

Calibration Techniques

- Verify that correct instrument operating conditions and routine maintenance as specified in the method and laboratory SOPs are employed. Document all maintenance activities in a laboratory notebook for troubleshooting and scheduling of future routine, periodic maintenance.

- Ensure that the instrument is free of contamination prior to calibration. Do NOT perform any blank subtraction.

- Perform the entire initial calibration before sample analyses. The calibration standards must be analyzed in a sequential order from the lowest to highest concentration. If **one** calibration standard fails to meet criteria, it may be reanalyzed at the end of the calibration sequence. Justification for removing a calibration point from the curve fit selected includes such items as improper purge, injection failure, non-spiked level, or other obvious failures. The failure of multiple standards suggests an instrument problem or operator error and corrective action is required.

- Determine calibration points. Only the lowest calibration point or the highest calibration point can be removed from the calibration curve without justification. If the lowest standard is removed, the reporting limit for that compound increases to the level of the next lowest calibration standard. Approval to elevate reporting limits greater than the project-specific objectives must be approved by the Project Chemist. If the highest standard is removed, the linear range is shortened for that compound.

- Ensure lowest standard in the calibration curve is at or below the required reporting limit.

- Ensure other standard concentrations define the working range of the instrument or the expected range of concentrations found in the samples.
- Use internal calibration when a mass spectrometry detector is employed.
- Use a minimum of five calibration points for the calibration curve for GC/MS methods.
- Determine whether a linear or non-linear approach should be used based on calibration data. Most compounds tend to be linear, and a linear approach will be favored when linearity is suggested by the calibration data. Non-linear calibration will be considered only when a linear approach cannot be applied. Before using a non-linear calibration approach, the Project Chemist must be notified and provide approval. It is not acceptable to use an alternate calibration procedure when a compound fails to perform in the usual manner. When this occurs, it is indicative of instrument problem or operator error.
- List analytes that exceed an RSD of greater than 20 percent in the case narrative. If the initial calibration of a given analyte exhibits a relative standard deviation (RSD) greater than 20 percent, but the average RSD for all analytes is less than 20 percent, a list of those analytes that exceeded the criteria will be provided in the laboratory report. For analyses conducted under this QAPP, compounds outside these criteria and the actual values of the RSD will be listed in the case narrative.

2.6.1.2 Calibration Options The following section outlines the acceptable calibration options and the hierarchy that the laboratory should use when selecting a specific option. The choice of calibration option may also be based on previous experience or a prior knowledge of detector response.

- **Linear calibration using average calibration or response factors.** Calibration factors for external calibrations or response factors for internal calibrations must have an RSD not exceeding 20 percent or 15 percent, respectively, to be used for quantitation. (For dioxins and furans by GC/MS, the maximum RSDs are 20 percent for unlabeled standards and 30 percent for labeled standards.) A minimum response factor of 0.05 for most target analytes and 0.01 for the least-responsive target analytes must be achieved to ensure detectability.
- **Linear calibration using a linear regression equation (y=mx+b).** The correlation coefficient must equal 0.995 or better. The line should NOT be forced through the origin. The equation and a plot of the linear regression must be included in the raw data generated by the laboratory and made available in the data package upon Honeywell's request.

2.6.1.3 Continuing Calibration

Periodic verification of the initial calibration is essential in generating analytical data of known quality. The continuing calibration verification analyses ensure that the instrument has not been adversely affected by the sample matrix or other instrument failures that would increase or decrease the sensitivity or accuracy of the method. The laboratory will

TABLE 7
Calibration and QC Requirements for SW8270C
Honeywell Former Celotex Site, Chicago, Illinois

QC Check	Frequency	Criteria	Corrective Action
DFTPP Tuning	Prior to initial calibration and calibration verification (every 12 hours)	Refer to criteria listed in the method	Retune instrument and verify
Multi-point initial calibration (minimum five points)	Prior to sample analysis, or when calibration verification fails	SPCCs average RF ≥ 0.050 and %RSD for RFs for CCCs ≤ 30% and one option below: Option 1: Mean %RSD for all analytes ≤ 15% with no individual analyte RSD > 30%, if using average RRFs	Correct the problem and repeat the initial calibration.
Second-source calibration verification	Once for each multi-point initial calibration	All analytes within ±25% of expected value	Correct the problem and repeat initial calibration
Continuing calibration verification	At the start of each analytical sequence, after every 12 hours or 10 samples, whichever is more frequent, and at the end of the sequence	SPCCs average RF ≥ 0.050 and %D for RFs for CCCs ≤ 20% All other analytes within ± 20% of expected value.	Correct the problem, then recalibrate and reanalyze all samples since the last acceptable continuing calibration verification.
Retention time window calculated for each analyte	Each analyte	Relative retention time of each analyte within ± 0.06 relative retention time units of the continuing calibration verification	Not applicable (used for identification of analyte)
Internal standards	Each sample and QC sample, method blank, MS/MSD and LCS	Retention time within ±30 seconds from retention time of the daily continuing calibration verification standard. EICP area within –50% to +100% of the daily continuing calibration verification standard	Inspect mass spectrometer and GC for malfunctions; reanalyze all affected samples
Method blank	At least one per analytical batch	No analytes detected at or above the reporting limit	Correct the problem, then re-prep and reanalyze all associated samples
Surrogate spike	Every standard, sample method blank, MS/MSD, and LCS	Three surrogates in samples, method blank, and LCS within limits specified in accuracy and precision table	Correct the problem and reanalyze (re-prep if necessary).
MS/MSD	One set per 20 project-specific samples	Within limits specified in Accuracy and Precision table	None
LCS	At least one per analytical batch	Within limits specified in Accuracy and Precision table	Correct the problem, then re-prep and reanalyze the LCS and all samples in the analytical batch.

CCC = Calibration check compounds
DFTPP = Decafluorotriphenylphosphine
EICP = Extracted ion current profile
LCS = Laboratory control sample
MS = Matrix spike
MSD = Matrix spike duplicate
RF = Response factor
RRF = Relative response factor

perform continuing calibration for all methods according to the specific requirements in the method and laboratory SOPs.

Method SW8000B allows the use of the average of all analytes' percent-drift or recovery to meet the continuing calibration requirements for the method, but is NOT allowed by the Honeywell Program QAPP.

2.7 Inspection/Acceptance Requirements for Supplies and Consumables

It is expected that several contractors will provide various services under multiple project tasks. The required services must meet the task scope, specified levels of quality, and the submittal schedule. Project contractors or vendors should have contractual arrangements with their material suppliers.

2.8 Nondirect Measurements

This subsection describes the identity of the types of data needed for project implementation and decision making not obtained from direct measurements.

The project objectives are first identified to assess the types of information needed to implement a project plan that meets the objectives stated in Section 1. Typically, the data needed to achieve project objectives include site maps, sampling location selection and sample identifiers, laboratory method selection and detection limit verification, analytical parameter lists and critical values, field measurement lists, and a project schedule. This information is included in this QAPP.

The sampling design and rationale of the sampling investigation activities were based upon previously collected data. Site maps and other site characterization data were used in the selection of sample locations.

2.9 Data Management Plan

The Data Management Plan (DMP) will be provided as a separate document. Sections 2.9.1 to 2.9.8 provide a limited overview as additional detail is contained in the DMP. The DMP outlines the procedures for storing, handling, accessing, and securing data collected during this sampling event. Data gathered during this sampling event will be consolidated and compiled into a project database system that can be used to evaluate site conditions and data trends. The DMP will serve as a guide for all database users. The DMP is subject to future revisions to allow the database management system to be modified as it is developed and maintained. The plan describes the following:

- The responsibilities of the project team for data management
- The Data Management System (DMS) to be established for the project
- The development of the base maps onto which the data will be plotted
- The types of data that will be entered into the DMS and the process of data entry

2.9.1 Team Organization and Responsibilities

The following are the team members and overview of their responsibilities for the data management process:

- **Site Manager and Project Chemist**—Establish the sample tracking system.
- **Project Chemist**—Tracks the COC forms and other sampling information. Reviews laboratory data for accuracy and quality and compares electronic outputs for accuracy to laboratory hard copies. Reviews data outputs, such as result tables, before use in final documents and submission to client.
- **Database Manager**—Sets up DMS in consultation with the project chemist at the beginning of the data evaluation task. Oversees the data management process including data conversion/manual entry into DMS, QC of the entered data, and preparation of the required tables and plots of the data.

2.9.2 Sample Tracking

The project chemist is responsible for tracking samples to ensure that the analytical results for all samples sent for analysis are received. The project chemist also tracks receipt of laboratory deliverables.

2.9.3 Data Types

Activities performed at the site will involve accessing a number of different types of data collected or retained for various uses. The following provides a general description of the overall contents of the project database, as based upon the available data and the data to be collected.

2.9.3.1 Historical Data

Sources of historical data for the residential study area include information collected by the Illinois Environmental Protection Agency and previous contractors to characterize residential soil conditions.

2.9.3.2 Site Characterization Data

Data will be added to the project database as available. The data will include new data collected in the field and laboratory and reviewed by CH2M HILL. The data source will be noted in the database. Procedures for incorporating the data into the database are presented in detail in the DMP.

2.9.4 Data Tracking and Management

Every data set received from analytical laboratories will be tracked as discussed in Section 2.9.2 of this QAPP.

2.9.4.1 Electronic Data Deliverables

EDDs will be submitted from the laboratory in the specified format.

2.9.4.2 Hard Copy

All raw analytical laboratory data are stored as the original hard copy. Hard copy information includes COC forms, analytical bench sheets, instrument printouts and chromatograms, certificates of analyses, and QA/QC report summaries.

2.9.4.3 Data Input Procedures

Sampling information, analytical results, applicable QA/QC data, data validation qualifiers, and other field-related information will be entered into the project database for storage and retrieval during data evaluation and report development.

2.9.5 LOCUS EIM Data Management System

The technical data, field observations, laboratory analytical results, and analytical data validation will be managed using Locus EIM®, a third-party database system to store and analyze project data submissions. The Locus EIM database system is based on a relational model, in which independent tables, each containing a certain type or entity of data, can be linked through selected fields that are common to two or more tables. This database design allows for the inclusion of historical data, and allows users to effectively conduct trend analysis and generate a variety of data reports to aid in data interpretation.

The Locus EIM DMS is protected from unauthorized access, tampering, accidental deletions or additions, and data or program loss that can result from power outages or hardware failure.

2.9.6 Documentation

Documentation of data management activities is critical because it provides the following:

- A hard copy record of project data management activities
- Reference information critical for database users
- Evidence that the activities have been properly planned, executed, and verified
- Continuity of data management operations when personnel changes occur

The DMP is the initial general documentation of the project data management efforts. Additional documentation will be maintained about specific issues, such as database structure definitions, database inventories, database maintenance, user requests, database issues and problems, and client contact.

2.9.7 Evidence File

The final evidence file will be the central repository for all documents that constitute evidence relevant to sampling and analysis activities. The CH2M HILL SM is the custodian of the evidence file and maintains the contents for the project, including relevant records, reports, logs, field notebooks, pictures, contractor reports, and data reviews in a secured area with limited access.

CH2M HILL will keep all records until project completion and closeout. As necessary, records may be transferred to an offsite records storage facility. The records storage facility

must provide secure, controlled-access records storage. Records of raw analytical laboratory data, QA data, and reports will be kept by the subcontract laboratory for at least 7 years.

2.9.8 Presentation of Site Characterization Data

Depending on the data user needs, data presentation may consist of any of the following formats:

- Tabulated results of data summaries or raw data
- Figures showing concentration isopleths or location-specific concentrations
- Tables providing statistical evaluation or calculation results

Other data may also be collected during field efforts, such as soil types. This information will be stored in the project database. Other types of data elements may be added as the field investigation needs and activities evolve.

SECTION 3

Assessment and Oversight

3.1 Assessments and Response Actions

Field and laboratory assessments will be performed to assess technical and procedural compliance with this QAPP. Performance and system audits are key to ensuring this compliance. The audits are conducted for the following purposes:

- Confirm that appropriate documents are properly completed and kept current and orderly.
- Ensure measurement systems are accurate.
- Identify nonconformance or deficiencies and to initiate necessary corrective actions.
- Verify that field and laboratory QA procedures called for in this QAPP are properly followed and executed.

The project chemist and the laboratory QAM are responsible for ensuring conformance with this QAPP and internal laboratory analytical SOPs (Appendix A). The SM and FTL are responsible for ensuring conformance with the FSP. Activities selected for audit will be evaluated against specified requirements, and the audit will include an evaluation of the method, procedures, and instructions. Documents and records will be examined as necessary to evaluate whether the QA program is effective and properly implemented. Reports and recommendations must be prepared on all audits and submitted to the QAM for retention in the project files.

3.1.1 Field Audits

3.1.1.1 Field Audit Procedures

Planning, scheduling, and conducting QA audits and surveillance are required to verify that site activities are being performed efficiently in conformance with approved plans, standards, federal and state regulatory requirements, sound scientific practices, and contractual requirements. Planned and scheduled audits may be performed to verify compliance with aspects of the QA program and to evaluate the effectiveness of the QA program. Audits include the following:

- Objective examination of work areas, activities, and processes
- Review of documents and records
- Interviews with project personnel
- Review of plans and standards

The FTL will conduct regular internal reviews of the sampling program during the investigation and pay particular attention to the sampling program with respect to

representativeness, comparability, and completeness of the specific measurement parameters involved.

The FTL or a designee will review field documentation (COC forms, field daily sheets, and logbooks) as it is generated for accuracy, completeness, and compliance with FSP and QAPP requirements. The FTL will also periodically audit field sampling procedures for compliance with QAPP procedures. The auditor will check that the following are performed:

- Sampling protocols are followed.
- Samples are placed in proper containers.
- Samples are stored and transported properly.
- Field documentation is completed.

The USEPA holds the right to perform field audits during sampling activities.

3.1.1.2 Field Corrective Action

Any project team member may initiate a field corrective action process. The process consists of identifying a problem, acting to eliminate it, monitoring the effectiveness of the corrective action, verifying that the problem has been eliminated, and documenting the corrective action.

Corrective actions include correcting COC forms, problems associated with sample collection, packaging, shipping, field record keeping, or acquiring additional training in sampling and analysis. Additional approaches may include re-sampling or evaluating and amending sampling procedures. The FTL will summarize the problem, establish possible causes, and designate the person responsible for a corrective action. The FTL will then verify that the initial action has been taken and appears effective and follow up to verify that the problem has been resolved.

Technical staff and project personnel will be responsible for reporting suspected technical or QA nonconformances or suspected deficiencies by reporting the situation to the FTL. The FTL will be responsible for assessing suspected problems in consultation with the QAM and the SM, and make a decision based on the situation's potential to impact data quality. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, the FTL will initiate a nonconformance report.

The FTL will be responsible for ensuring that corrective actions for nonconformances are initiated by:

- Evaluating all reported nonconformances
- Controlling additional work on nonconforming items
- Determining disposition or action to be taken
- Maintaining a log of nonconformances
- Reviewing nonconformance reports and corrective actions taken
- Ensuring that nonconformance reports are included in the final documentation in the project files

3.1.2 Laboratory Audits

3.1.2.1 Laboratory Audit Procedures

The laboratory QAM may conduct internal system audits, which are qualitative evaluations of all components of the laboratory QC measurement system. The audit serves to determine if all measurement systems are used appropriately. The system audits are conducted to evaluate the following:

- Sample handling procedures
- Calibration procedures
- Analytical procedures
- QC results
- Safety procedures
- Record keeping procedures
- Timeliness of analysis and reporting

Laboratories also are subject to external audits, which focus on assessing general laboratory practices and conformance to this QAPP. Laboratory audits may be performed before the start of analyses and at any time during the course of the project as deemed necessary.

The laboratory QAM will review internal laboratory performance. The laboratory QAM will evaluate laboratory precision and accuracy by comparing results of duplicate samples, QC samples, spikes, and blanks. The laboratory QAM or other client services individual will check the analytical data prior to distribution when a "beyond-control-limit" situation is encountered.

External laboratory performance reviews may be conducted based on evaluation of the results of check samples analyzed as part of USEPA or state certification requirements. Performance audits may be conducted by sending "double blind" performance evaluation samples to the analytical laboratory (those not discernable from routine field samples).

3.1.2.2 Laboratory Corrective Action

Corrective actions may be required for two classes of problems: analytical/equipment problems and noncompliance problems. Analytical/equipment problems may occur during sampling, sample handling, sample preparation, laboratory instrumental analysis, or data review.

A corrective action program will be determined and implemented when a noncompliance problem is identified. The person identifying the problem will be responsible for notifying the proper project member. If the problem is analytical in nature, information on the problem will be communicated to the laboratory QAM and the project chemist, who will in turn direct information to proper project members.

Corrective actions are required whenever an actual or potential "out-of-control" event is noted. The specific investigative action taken will depend on the analysis and the event in question. Laboratory personnel are alerted that corrective action may be necessary if any of the following occur:

- QC data are outside the warning or acceptable windows for precision and accuracy.

- Blanks contain target analytes above acceptable levels.
- Undesirable trends are detected in spike recoveries or relative percent difference between duplicates.
- Unusual changes in detection limits occur.
- Inquiries concerning data quality are received.
- Deficiencies are detected by the laboratory QAM during internal or external audits or from results of performance evaluation samples.

Corrective action procedures in the laboratory are often handled at the bench level by the analyst who reviews preparation or extraction procedures for possible errors, checks instrument calibrations, spike and calibration mixes, and instrument sensitivity. If problems persist or cannot be identified, matters are referred to the laboratory supervisor, laboratory project manager, or laboratory QAM for further investigation. The laboratory project manager is to contact CH2M HILL's project chemist to discuss any corrective action needed. Once resolved, full documentation of the corrective action procedures is filed with the Laboratory QAM after approval by the SM or the project chemist. Corrective action may include the following:

- Resampling and analyzing
- Evaluating and amending sampling procedures
- Evaluating and amending analytical procedures
- Accepting data and acknowledging the level of uncertainty
- Reanalyzing the samples, if sample or extract volume is adequate and holding time criteria permit

If resampling is deemed necessary because of laboratory problems, the project chemist and the SM together must identify the appropriate course of action to be taken, including potential cost recovery from the laboratory for the additional sampling effort.

3.2 Reports to Management

In addition to the audit reports that may be submitted to the SM in accordance with this QAPP, the SM prepares a progress report that addresses QA issues and corrective actions proposed or already taken. After sample results have been received from the laboratory and evaluated, reduced, and tabulated, a data evaluation report will be submitted to the Program Manager that documents the field investigation.

SECTION 4

Data Validation and Usability

4.1 Data Review, Verification, and Validation

4.1.1 Data Validation Process

Data validation is the process by which data generated in support of a project are reviewed against the data QA/QC requirements. The data are evaluated for precision and accuracy against the analytical protocol requirements. Nonconformance or deficiencies that could affect the precision or accuracy of the reported result are identified and noted. The effect on the result is then considered when assessing whether the result is sufficient to achieve DQOs.

Deficiencies discovered as a result of data validation, as well as corrective actions implemented in response, will be documented and submitted in the form of a written report with supporting documentation supplied as check sheets. Data validation will be patterned after the USEPA *Contract Laboratory National Functional Guidelines for Organic Data Review* (1999). The flagging criteria in Table 8 will be used as guidance. The qualifier flags are defined in Table 9.

The analytical results of the data collection effort will be validated by CH2M HILL. Four levels of validation correspond to the reports described in Section 1.8.2. Levels 1 and 2 may be performed by the project chemist or other program team members. Levels 3 and 4 validation will always be performed by the project chemist or his/her designee. For this project, only Level 3 and Level 4 validation will be performed.

Level 1 — Verification that samples were analyzed for the methods requested and review of the data for outliers and anomalies.

Level 2 — Verification that samples were analyzed for the methods requested, review of the laboratory case narrative for events in the laboratory that affect the accuracy or precision of the data, review of quality control indicator data, and a "reasonableness" review of the data.

Level 3 — Validation of the analytical data as described below without review of any raw data or analyte verification.

Level 4 — Validation of the analytical data will be performed as described below, including review of the analytical raw data.

4.1.2 Levels 3 and 4 Validation Procedures

Personnel involved in data validation will be independent of any data generation effort. The project chemist will be responsible for oversight of data validation. Data validation will be carried out when the data packages are received from the laboratory. It will be performed on an analytical batch basis using the summary results of calibration and laboratory quality

control, as well as those of the associated field samples. For this project, Level 3 data validation will be performed on 100 percent of the data packages. An additional Level 4 validation (review of the raw data) will be performed on approximately 50 percent of the data packages. Validation will be performed using the following procedures and those referenced for Level 3 or 4, as appropriate:

- A review of the data set narrative to identify any issues that the lab reported in the data deliverable
- A check of sample integrity (sample collection, preservation, and holding times)
- An evaluation of basic QC measurements used to assess the accuracy, precision, and representativeness of data, including QC blanks, LCSs, matrix spikes/matrix spike duplicates (MS/MSD), surrogate recovery when applicable, and field or laboratory duplicate results
- A review of sample results, target compound lists, and detection limits to verify that project analytical requirements are met
- Initiation of corrective actions, as necessary, based on the data review findings
- Qualification of the data using appropriate qualifier flags, as necessary, to reflect data usability limitations

Level 3 validation procedures will also include reviewing the evaluation of calibration and quality control summary results against the project requirements and other method-specific QC requirements.

Level 4 validations will include reviewing sample chromatograms and verification of analyte identification and calculations for at least 50 percent of the data.

Qualifier flags, if required, will be applied to the electronic sample results. If multiple flags are required for a result, the most severe flag will be applied to the electronic result. The hierarchy of flags from the most severe to the least severe will be as follows: R, UJ, U, and J.

Any significant data quality problems will be brought to the attention of the project chemist.

TABLE 8
Flagging Conventions for PAHs
Honeywell Former Celotex Site, Chicago, Illinois

Quality Control Check	Evaluation	Flag	Samples Affected
Holding Time	**Holding time exceeded for extraction or analysis**	J positive results	Affected samples
	By a factor of two	R non-detects	
Temperature	Temperature exceedance >10°C if received within 24 hours)	UJ non-detects	
	Temperature exceedance >6°C if received > 24 hours)	UJ non-detects, J positive results	
Sample preservation	**Sample preservation requirements not met**	J positive results	Affected samples
	If preservation is not performed in the field, but performed in the laboratory upon receipt, no flagging is required	R non-detects	
Sample Integrity	Professional judgment on sample condition	J positive results/professional judgment	Affected samples
	Example: Bubbles in VOA vial used for analysis	R non-detects/professional judgment	
GC/MS Instrument Performance Check	**Mass assignment in error and laboratory cannot reprocess data**	R all results	All samples in batch
	Ion abundance criteria not met	R all results if critical ions involved, use judgment otherwise	All samples in batch
Initial Calibration GC/MS Methods	**RRF <0.050**	J positive results	Analyte in associated samples
		UJ non-detects	
	%RSD > 30% and no calibration curve used or linear calibration curve used and R < 0.990	J positive results	Analyte in associated samples
		UJ non-detects	

TABLE 8
Flagging Conventions for PAHs
Honeywell Former Celotex Site, Chicago, Illinois

Quality Control Check	Evaluation	Flag	Samples Affected
Continuing Calibration Verification (CCV)	**RRF <0.050**	J positive results, UJ non-detects	Analyte in associated samples
GC/MS Methods	RRF <0.010	J positive results, UJ non-detects	Analyte in associated samples
(Second source and CCV)	**% difference or % drift >25% with high recovery**	J positive results	Analyte in associated samples
		No flag applied to non-detects	Analyte in associated samples
	% difference or % drift >25% with low recovery	J positive results	Analyte in associated samples
		UJ non-detects	
Laboratory Control Sample (LCS)	%R >UCL	J positive results	Analyte in associated samples
		No flag applied to non-detects	
	%R <LCL but ≥10%	J positive results	Analyte in associated samples
		UJ non-detects	
	%R <LCL but ≤10%	J positive results	Analyte in associated samples
		R non-detects	
Method Blank (MB) <RL	**Convert blank to soil units if necessary, multiply highest blank value by 5**	U positive results < 5 x highest blank concentration	All associated samples in batch
Equipment Blank (Field Blank (FB)) <RL	**Convert blank to soil units if necessary, multiply highest blank value by 5**	U positive results < 5 x highest blank concentration	All associated samples in batch

TABLE 8
Flagging Conventions for PAHs
Honeywell Former Celotex Site, Chicago, Illinois

Quality Control Check	Evaluation	Flag	Samples Affected
Matrix Spike/Matrix Spike Duplicates (MS/MSD) does not apply if sample result is greater than four times the spike value	**%R >UCL**	J positive results No flag applied to non-detects	Parent sample
	%R <LCL but ≥10%	J positive results UJ non-detects	Parent sample
	%R <LCL but ≤10%	J positive results R non-detects	Parent sample
	RPD >UCL	J positive results No flag applied to non-detects	Parent sample
Surrogates - SW8270.	**Two or more surrogates with %R >UCL**	J positive results No flag applied to non-detects	Parent sample
	Two or more surrogates with %R <LCL but ≥10%	J positive results UJ non-detects	Parent sample
	Two or more surrogates with %R <LCL but ≤10%	J positive results R non-detects	Parent sample
Internal Standards -50% to +100% recovery	**Area > UCL**	J positive results UJ non-detects	Associated analytes in sample
	Area < LCL	J positive results UJ non-detects	Associated analytes in sample

TABLE 8
Flagging Conventions for PAHs
Honeywell Former Celotex Site, Chicago, Illinois

Quality Control Check	Evaluation	Flag	Samples Affected
	Area < 10%	J positive results R non-detects	
Field Duplicates ± 50% precision for soil ± 30% precision for aqueous	**Both sample results >5 times RL and RPD>UCL**	J positive results	Field duplicate pair
	One or both samples <5 times RL and a difference between results of ± 2 times RL for water and ± 3.5 times RL for soil	J positive results UJ non detects	Field duplicate pair

C = Celsius
CCV = Calibration check verification
GC/MS = Gas chromatograph / mass spectrometer
LCL = Lower control limit
R = Recovery
RL = Reporting limits
RPD = Relative percent difference
RRF = Relative response factor
RSD = Relative standard deviation
UCL = Upper control limit
VOA = Volatile organic analysis

TABLE 9
Qualifier Flag Definitions
Honeywell Former Celotex Site, Chicago, Illinois

Flag	Definition
J	Analyte was present but reported value may not be accurate or precise.
R	This result has been rejected.
U	This analyte was analyzed for but not detected at the specified detection limit.
UJ	The analyte was not detected above the detection limit objective. However, the reported detection limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

4.2 Validation and Verification Methods

The data validation process is conducted to assess the effect of the overall sampling and analysis process on the usability of the data. There are two areas of review: laboratory performance evaluation and the effect of matrix and sampling interference. The laboratory performance evaluation is a check for compliance with the method requirements and a straightforward examination. The laboratory either did or did not analyze the samples within the QC limits of the analytical method and according to protocol requirements. The assessment of potential matrix and sampling affects consists of a QC evaluation of the analytical results; the results of blank, duplicate, and matrix spike samples; and then assessing how, if at all, this could affect the usability of the data.

All analytical data will be supported by a data package. The data package will contain the supporting QC data for the associated field samples (see Section 1.8.2 of this QAPP for the data package content requirements). Before the laboratory will release each data package, the laboratory QAM (or the analytical section supervisor) must carefully review the sample and laboratory performance QC data to verify sample identity, the completeness and accuracy of the sample and QC data, and compliance with method specifications.

CH2M HILL will perform data validation for all sub-contracted laboratory generated data for samples also in a manner consistent with the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA 1999) and Table 8. Sample results will then be assigned a degree of usability based upon overall data quality.

The CH2M HILL project team will evaluate the data validation results. This evaluation will assess how the data, as qualified by the data validation, can be used on the project.

The data, after validation, will also be verified to assess if the correct samples were analyzed and the correct parameters were reported. The data are also verified to assess if the EDDs and the hard copy data deliverables are consistent with one another to ensure an accurate database. Also, the data will be evaluated to determine whether the results make sense in comparison to that anticipated. If the data is consistent with anticipated results, no corrective action will be deemed necessary. However, if the data obtained from the laboratory are not consistent with the anticipated results, an in-depth evaluation of the results may be necessary to interpret the deviation.

4.3 Reconciliation with Data Quality Objectives

The final activity of the data validation process is to assess whether the data fulfilled the planned objectives for the project. The final results, as adjusted for the findings of any data validation/data evaluation, will be checked against the DQOs. The data acquired from the additional site investigation should fulfill the project objective to fill in any data gaps left from the previous site investigation and aid in determining the most appropriate remediation method.

The data collected from the sampling investigation will be evaluated to assess if the project objectives have been met. The objectives will be met if all scheduled samples and data readings documented in this QAPP are obtainable, and all the data are deemed usable after validation and evaluation. If the objectives are not met, data collection will be required and implemented accordingly. If the data, after validation and evaluation, are sufficient to achieve project objectives, the QAM and SM will release the data and work may proceed.

SECTION 5

References

CH2M HILL. 2006. *Residential Soil Sampling Work Plan for the Residential Study Area Near the Former Celotex Site.* June.

USEPA. 2000. *Region 5 – Instructions on the Preparation of a Superfund Division Quality Assurance Project Plan.* Based on EPA QA/R-5.

USEPA. 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.* EPA-540/R-99-008 (PB99-963506)

USEPA. 1996. *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, SW-846, 3rd Edition, Update IIIB.*

Appendix A
Analytical Standard Operating Procedures

Low-Level Extraction Procedure for the Determination of PAHs in a Solid Matrix by GC/MS

Reference:

Method 3550B, SW-846. Rev. 2, 12/96

Cross Reference:

The following procedures are cross-referenced in this document:

Document	Document Title
MC-OE-002	Ultrasonic Processor Maintenance and Tuning
SOP-EX-001	Semivolatile Spiking and Calibration Standards
SOP-OE-001	Glassware Cleaning for Organic Extractions

Scope:

This procedure is applicable for the extraction of PAHs at low ppm levels from soils or solid wastes. Conditions such as high levels of organic compounds may interfere with normal detection limits.

Interferences:

Method interferences may be caused by impurities in solvents, reagents, glassware, or other hardware used in sample processing. All glassware is rinsed with solvent before use and a method blank is performed with each batch of sample to demonstrate that the extraction system is free of contaminants.

Basic Principles:

A portion of sample to be analyzed is placed in a beaker. Anhydrous sodium sulfate is added to absorb any water which may be present. Surrogate standards are added to each sample to monitor recovery (see SOP-EX-001 for preparation). An aliquot of solvent is then added to the sample. The sample is subjected to sonic disruption to disperse the soil and force solvent contact. The organic compounds present in the soil dissolve in the solvent which is then removed. The sample is extracted two more times

with fresh solvent, the solvent fractions are combined and concentrated to below 1 mL. The extract is brought to 1.0 mL and bottled in an amber autosampler vial. It is stored in the freezer until analysis.

Holding Times:

Samples should be extracted within 14 days of collection. All samples should be stored at 2° to 4°C prior to extraction.

Personnel Training and Qualifications:

All personnel performing these techniques should have performed a solvent concentration quad study that yielded acceptable recoveries for semivolatile LCS compounds. Personnel should spend several days working with an experienced preparation technician who has demonstrated their proficiency of the extraction. Also, several batches of semivolatile samples should be performed under the direct observation of another experienced preparation technician to assure the trainee is capable of independent preparation.

Apparatus and Equipment:

1. Sonic probe apparatus for extracting organic components from a soil matrix with a minimum of 300W output, heat systems Model W-385 or equivalent

2. Kuderna-Danish assembly with appropriate ampule for concentrating the solvent used during concentration

3. Water bath – VWR/LLI Model #1127 or equivalent

4. Filter paper – 90 mm Fisher brand glass fiber filter circles or equivalent

5. Stainless steel beakers – Assorted sizes

6. Balance – Capable of weighing to 0.01 g

7. Pipettes – Class A, assorted sizes

8. Solvent dispenser – Beckman, adjustable

9. Vacuum filtration assembly

10. Wash bottles, Teflon

11. Teflon boiling chips

12. Disposable pipettes

13. Amber autosampler vials

Reagents and Standards:

1. Methylene chloride – Pesticide grade or equivalent

2. Acetone – Semivolatile grade or equivalent

3. Sodium sulfate – Reagent grade or equivalent. Bake at 400°C for 4 hours in a shallow pan prior to use to remove organic contaminants. Store in a glass jar for up to 1 year after baking.

Preparation of Glassware:

See SOP-OE-001.

Safety Precautions:

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available such as fume hoods, lab coats, safety glasses, and gloves.

Since the extracts are concentrated on a steam bath, caution must be exercised while working around this apparatus.

All solvent waste generated from this preparation must be collected for recycling (if applicable) or must be disposed of in the designated containers. These will then be transferred to the lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) may be disposed of in the normal solid waste collection containers.

Procedure:

1. Weigh out 30 ± .04 g of sample into a labeled stainless steel beaker. Record in the extraction log the initial weight to the nearest 0.1-g and any comments about the sample.

   The background, MS, and MSD are prepared in three separate aliquots of a field sample.

2. Add at least 60 g of anhydrous powdered sodium sulfate and mix well. Additional sodium sulfate may be added to obtain a free-flowing mixture.

   The blank, LCS, LCSD (if applicable) are prepared using 30 ± .04 g of sodium sulfate weighed into a stainless steel beaker. Record the weight on the extraction log.

3. Using a pipette, add 1.0 mL of PAH by GCMS surrogate standard into the beaker. Also add 1.0 mL of PAH by GCMS matrix spiking solution to the matrix spike, matrix spike duplicate, and the laboratory control sample. If the sample requires any compounds in addition to the PAH compounds, 1.0 mL of a 100-ppm spike of this compound is added at this time (see SOP-EX-001).

4. Using a solvent dispenser add 100 mL of 50% acetone in methylene chloride.

5. Set up the sonic probe as described in the manual (see MC-OE-002).

6. Immerse the tip of the sonic probe approximately 1 to 2 cm below the surface of the liquid in the beaker containing the sample and above the sediment layer.

7. Disrupt the sample using a medium tip at full output of 10 and a process time/timer of 1:30.

   NOTE: *This is equivalent to 3 minutes, 50% duty cycle as described in the* EPA method.

8. Remove the probe from the sample and decant the liquid from the beaker. Filter through Fisher brand G 6 glass fiber filter circles using vacuum filtration.

   NOTE: Be sure to turn the vacuum off immediately after solvent is no longer observed dripping from the funnel.

9. Using a solvent dispenser, add 100 mL of fresh solvent to the sample and repeat steps 6 through 8.

10. Using a solvent pump, add 100 mL of fresh solvent to the sample and repeat steps 6 through 8. Pour the liquid and solids from the beaker onto the filter paper. Using a wash bottle, rinse the beaker and filter paper with approximately 30 mL of 50% acetone in methylene chloride.

    Before placing the probe into another sample, wipe the probe using a paper towel wetted with deionized water to remove any soil present from the previous sample. Rinse the probe with acetone to remove water.

11. Pour the collected extract into a Kuderna-Danish assembly containing a Teflon boiling chip. Place a 3-ball Snyder column on the setup, wet the column with methylene chloride, and concentrate over a steam bath which is at 85° to 95°C to about 1 mL. Allow the sample to cool 10 minutes. Approximately 3 mL will condense into the ampule during this time.

    This steam bath temperature ensures concentration in a reasonable length of time.

NOTE: To reduce burnout of heating elements, do not allow the water level in the steam bath to go below 5 cm from the top of the bath.

12. Attach the ampule of the K-D to a micro-Snyder column and concentrate the extract to below 1 mL. Allow the sample to cool.

13. Bring to a final volume of 1.0 mL with methylene chloride. The final volume is determined by placing the extract into an amber autosampler vial and comparing the level in the vial to a reference vial containing the exact targeted final volume. Methylene chloride is added to the extract using a disposable pipette until exactly the same level is in both vials. If too much solvent is added to the sample vial, remove the extract from the vial and concentrate it to slightly less than the targeted final volume and rebottle. Cap the vial and store in the freezer until analysis. Record the final volume in the extraction log.

Calculations:

See analysis method.

Statistical Information:

See analysis method.

Quality Assurance/Quality control:

For each batch of samples extracted, a blank, a laboratory control sample (LCS) (sodium sulfate blank spiked with all compounds to be determined carried through the entire procedure) a matrix spike, and matrix spike duplicate must be extracted. If insufficient volume of sample is available for MS/MSD, then an LCSD must be prepared instead. A batch is defined as the samples to be extracted on any given day but not to

exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared. If any client, state, or agency has more stringent QC or batching requirements, these must be followed.

Revision Log:

Ver. #	Effective Date	Change
00	11/04/96	Previous Issue
01	09/15/97	Major changes as follows: • Added holding times. • Removed GPC cleanup procedure. • Added statement of following specific client and state requirements to Quality Assurance.
02	01/29/98	Major changes: • Updated method reference
03	04/05/99	Major changes are as follows: • Reagents - Added length of time Na_2SO_4 can be stored after baking • Update glassware cleaning • Procedure - Clarified final volume determination • Quality Assurance - Batch per day
04	06/14/01	Major changes are as follows: • Added Cross Reference section • Apparatus – Clarified • Procedure – Clarified Updated spiking solution • Changed Title

Ver. #	Effective Date	Change
05	SEP 1 9 2003	Major changes are as follows: • Reformatted to Level 3 • Interferences – Section added • Apparatus and Equipment – Section revised • Procedure – Section revised

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Prepared by: _____ (092) Date: 8-20-03
Senior Chemist

Approved by: _____ Date: 9/5/03
GC/MS Semivolatiles Management

Approved by: _____ Date: 9.2.03
Organic Extraction Management

Approved by: _____ Date: 9/5/03
Quality Assurance

Extraction Procedure for the Determination of Polynuclear Aromatic Hydrocarbons (PAH) in Water and Wastewater by GC/MS

Reference:

Method 3510C, SW-846.

Cross Reference:

The following procedures are cross-referenced in this document:

Document	Document Title
SOP-EX -001	Semivolatile Spiking and Calibration Standards
SOP-OE-001	Glassware Cleaning for Organic Extractions

Scope:

This method is suitable for the extraction of PAH compounds at low ppb to low ppm levels in water and wastewater matrices which are not prone to emulsions. Conditions such as high levels of organic compounds and/or extreme alkalinity or acidity in the sample may interfere with normal detection limits.

Interferences:

Method interferences may be caused by impurities in solvents, reagents, glassware, or other hardware used in sample processing. All glassware is rinsed with solvent before use and a method blank is performed with each batch of sample to demonstrate that the extraction system is free of contaminants.

Basic Principles:

1 L of the sample to be analyzed is placed into a 2-L separatory funnel. A surrogate standard is added to the sample to monitor recovery (see SOP-EX-001 for preparation). The pH of the sample is adjusted to 2 and the sample is serially extracted with methylene chloride. The extract is concentrated to 1.0 mL and stored in the freezer up to 40 days prior to analysis.

Holding Time:

Samples should be extracted within 7 days of collection. All samples should be stored at 2° to 4°C prior to extraction.

Personnel Training and Qualifications:

All personnel performing these techniques should have performed a solvent concentration quad study that yielded acceptable recoveries for semivolatile LCS compounds. Personnel should spend several days working with an experienced preparation technician who has demonstrated their proficiency of the extraction. Also, several batches of semivolatile samples should be performed under the direct observation of another experienced preparation technician to assure the trainee is capable of independent preparation.

Apparatus and Equipment:

1. 2-L separatory funnel for extracting organic components from an aqueous matrix

2. Kuderna-Danish (K-D) assembly with appropriate ampule for concentrating the solvent used during the extraction

3. Water bath – VWR/LLI Model #1127 or equivalent

4. Graduated cylinder – Class A, assorted sizes
5. Pipettes – Class A, assorted sizes
6. Pipettes – Disposable
7. Solvent pumps – Beckman, adjustable
8. Balance – Capable of weighing to 0.01 g
9. Automatic shaker – Capable of holding 2 L separatory funnels
10. Centrifuge – Beckman GS-6 or equivalent
11. Sodium sulfate columns
12. Micro-snyder columns
13. Wash bottles – Teflon
14. Amber autosampler vials
15. Teflon boiling chips

Reagents and Standards:

1. Methylene chloride – Pesticide grade or equivalent
2. Sulfuric acid – Baker Instra-analyzed or equivalent

3. Sodium sulfate, reagent grade or equivalent – Bake at 400°C for 4 hours in a shallow pan to remove contaminants. Store in a glass jar for up to 1 year after baking.

Preparation of Glassware:

See SOP-OE-001.

Safety Precautions:

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, and gloves.

Since the extracts are concentrated on a steam-bath, caution must be exercised while working around this apparatus. All solvent waste generated from this preparation must be collected for recycling (if applicable) or must be disposed of in the designated containers. These will then be transferred to the lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) may be disposed of in the normal solid waste collection containers.

Procedure:

1. If the sample bottle is a 1-L bottle and is not a quality control sample (BG, MS, MSD), mark the water level on the outside of the sample bottle in order to later determine the sample volume. Shake the bottle vigorously, then pour the sample into the separatory funnel. Record any comments about the sample in the extraction log. If the sample bottle is larger than 1 L, or the sample is a client paid quality control sample, exactly 1 L of sample is extracted. Shake the sample bottle vigorously, then, using a clean

graduated cylinder, measure 1 L of the sample and pour it into the separatory funnel. Using a wash bottle, record the initial volume and any comments about the sample in the extraction log. Rinse the graduated cylinder with methylene chloride and add the rinseate to the separatory funnel.

The background, MS, and MSD are performed on three separate aliquots of a field sample.

The blank, LCS, and LCSD (if applicable) are prepared using 1 L of deionized water measured into the separatory funnel.

2. Using a pipette, measure 1.0 mL of PAH by GC/MS surrogate and add it to the aqueous sample in the separatory funnel (see SOP-EX-001 for preparation).

3. Using a pipette, add 1.0 mL of the PAH by GC/MS matrix spiking solution to the matrix spike, matrix spike duplicate, laboratory control sample (LCS) and LCSD if applicable. If the sample requires any compounds in addition to the PAH compounds, 1.0 mL of a 100-ppm spike of this compound is added at this time (see SOP-EX-001 for preparation).

   EPA Method Deviation:

   Surrogate and matrix spiking solutions are not added before the transfer to the separatory funnel for several reasons:

   a. Samples must be poured from the amber bottles to determine the sample matrix.

   b. Many sample bottles have no headspace and there is no room to add surrogate to the sample in the bottle.

c. Due to the volume of samples extracted, a separate graduated cylinder for each sample is unrealistic.

d. To maintain consistency with all extractions, no samples will be spiked in the bottle or graduated cylinders.

4. Using sulfuric acid, adjust the pH of the sample to 2. This pH ensures the extraction of all neutral analytes. A disposable pipette should be used to add the acid to the sample.

5. If the sample container is empty, using a solvent pump measure 60 mL of methylene chloride and rinse the sample container, then add the rinseate to the separatory funnel. After the sample bottle is rinsed with methylene chloride, fill the bottle to the marked level with water and transfer the water to a graduated cylinder to determine the initial volume. Alternatively, weigh the empty bottle and tare the balance. Fill the bottle to the marked level with water and place the bottle onto the tared balance. This weight, rounded to a whole number, is the initial sample volume. Record the initial volume on the extraction sheet. If the container is not empty, using a solvent pump measure 60 mL of methylene chloride and add the solvent directly to the separatory funnel.

6. Cap the funnel, invert it, and vent immediately. Handshake and vent frequently until the pressure is stable. Place the separatory funnel on the automatic shaker and shake at the designated speed for 2 minutes with the stopcock closed.

   NOTE: Shaker speeds vary greatly between instruments so the proper setting is marked on each.

7. Place the separatory funnel into the rack and allow it to sit undisturbed for 10 minutes. This allows the organic and aqueous layers to separate. If an emulsion forms and is > 1/3 the volume of the solvent layer, mechanical techniques such as stirring and centrifugation must be employed to complete the separation.

8. Remove the solvent layer and allow it to flow through approximately 10 cm of sodium sulfate into a K-D apparatus containing a Teflon boiling chip.

9. Using a solvent pump, add 60 mL of methylene chloride to the separatory funnel and repeat steps 6 through 8 venting only as necessary.

10. Using a solvent pump, add 60 mL of methylene chloride to the separatory funnel and repeat steps 6 through 8, venting only as necessary.

11. Using a wash bottle, rinse the sodium sulfate column with approximately 20 mL of methylene chloride.

12. Attach a 3-ball Snyder column to the K-D, wet with solvent, and concentrate the extract to approximately 1 mL on a steam bath at 80° to 90°C. Allow the sample to cool 10 minutes. Approximately 3 mL will condense into the ampule during this time.

    This steam bath temperature ensures concentration in a reasonable length of time.

    NOTE: To reduce the burn out of heating elements, do not allow the water level in the steam-bath/S-Evap to go below 5 cm from the top of the bath.

13. Attach the ampule of the K-D to a micro-Snyder column, and concentrate the extract slightly less than 1 mL; allow the extract to cool.

14. Place the extract into the autosampler vial. Place the vial containing the extract next to a reference vial containing exactly 1 mL. Add methylene chloride to the extract using a disposable pipette until exactly the same level is in both vials. If too much solvent is added to the vial, remove the extract from the vial and concentrate it by microsnydering to slightly less than 1 mL and rebottle. Cap securely and store in the freezer. Record the final volume in the extraction log.

Calculations:

See analysis method.

Statistical Information:

See analysis method.

Quality Assurance/Quality Control:

For each batch of samples extracted, a blank, a laboratory control sample (LCS) (deionized water spiked with all compounds to be determined carried through the entire procedure), a matrix spike, and matrix spike duplicate must be extracted. If insufficient volume of sample is available for MS/MSD, then an LCSD must be prepared instead. Also, if a batch contains only field or equipment blank samples, the LCS/LCSD QC pairing should be used. A batch is defined as the samples to be extracted on any given day, but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared. If any client, state, or agency has more stringent QC or batching requirements, these must be followed instead.

Revision Log:

Ver. #	Effective Date	Change
00	11/05/96	Previous Issue
01	09/15/97	Major changes are as follows: • Added Holding Time section • Added statement of following state or client requirements in Quality Assurance section
02	01/29/98	Major changes are as follows: • Update method reference • Update determination of initial sample volume
03	04/05/99	Major changes are as follows: • Updated Glassware Cleaning section • Procedure section – updated determination of initial volume; clarified determination of final volume • Quality Assurance section – changed to batch per day
04	06/15/01	Major changes are as follows: • Added Cross Reference section • Apparatus – Clarified • Procedure – Clarified Updated spiking solutions
05	OCT 01 2003	Major changes are as follows: • Reformatted to Level 3 • Added Interference section

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Approved by: _____ (092) Date: 9-4-03
Senior Chemist

Approved by: _____ Date: 9/12/03
GC/MS Semivolatiles Management

Approved by: _____ Date: 9.8.03
Organic Extraction Management

Approved by: _____ Date: 9/17/03
Quality Assurance

Determination of Semivolatile Organic Compounds by Method 8270C

Reference:

1. Method 8270C, USEPA SW-846
2. Method 8000B, USEPA SW-846
3. *Federal Register*, Vol. 57, No. 227, November 24, 1992, p. 55114 (TCLP).
4. Federal Register, Vol. 57, No. 160, August 18, 1992, p. 37203 (CCW).
5. GC/MS Semivolatiles Training Manual.
6. Lancaster Laboratories Chemical Hygiene Plan.

Cross Reference:

Document	Document Title
MC-EX-001	GC/MS Preventative and Corrective Maintenance
SOP-EX-001	Semivolatile Spiking and Calibration Standards
Form 2586	Nonconformance Form

Scope:

This method is suitable for the determination of the concentration of certain semivolatile organic compounds (priority pollutant list, target compound list, Appendix IX list, TCLP list, and CCW list) found in soils, waters, and leachates. Typical limits of detection achieved are 33 ug/kg for soils, 1 ug/L for waters and 0.002 mg/L for leachates. Specific compound lists and associated MDLs/LOQs can be found in the Environmental Sciences Division (ESD) Laboratory Information Management System (LIMS) under the analysis numbers listed in the header of this SOP.

Basic Principles:

A 1-microliter mixture of organic compounds in methylene chloride is injected onto a fused silica capillary column coated with a relatively non- polar stationary phase, which is enclosed in a temperature controlled oven. A carrier gas, ultra pure helium, passes continuously through the column. The GC oven is temperature programmed and the organic mixture separates into its individual components as it moves along the length of the column. This separation is a function of the polarity and boiling point of the individual compounds. The column empties into a mass selective detector. When a compound reaches the detector, it is bombarded by high energy electrons (70 eV). This causes the compounds to fragment, forming ions. By applying various voltages to lenses in the area where the ions are formed, the positive ions are thrust into a quadruple mass analyzer, which selects for a given mass fragment at a given time. These selected fragments reach an electron multiplier, which detects and generates a signal for each mass fragment. The signals are amplified and sent to a computer making storage and manipulation of the data possible. Target compounds are identified on the basis of relative retention times and spectral match to standards. Standards are injected every 12 hours on each system used for analysis.

Quantification is achieved via use of the internal standard calibration technique. The average relative response factor of a multi-point calibration is used for quantification when the appropriate criteria are met.

Personnel Training and Qualifications:

Education Requirement: Degree in science or relevant experience

Each new chemist will train with an experienced chemist for the first 12 weeks. The first 12 weeks are spent working one-on-one with the trainer. This time may be less if the new chemist has prior experience in the GC/MS Semivolatiles area or relevant analytical chemistry background. Each new chemist receives a training manual outlining the basics of operating the GC/MS and data work up.

During the training period, the new chemist will learn daily maintenance, column and source changing procedures, calibration techniques, data and library search review, and forms generation. They are also required to read all relevant SOPs and EPA methods.

To measure the proficiency of each chemist, several checks have been established. The first is the ability to calibrate for each method. The chemist will run a series of at least five calibration standards and perform the calibration routine. A departmental data validator will then review the curve. They will confirm that relative retention times (RRT) and response factors (RF) match throughout the calibration and ID list. Secondly, each analyst must perform a quad study. This will consist of serial dilutions on a known concentration mixture and analyzing four back-to-back replicates of these dilutions. This process will measure accuracy in dilution preparation as well as reproducibility of results. It is a requirement that quad studies are performed by each analyst on an annual basis.

Interferences:

Method interferences may be caused by impurities in solvents, reagents, and glassware, or other hardware using in the processing of samples. All glassware is solvent rinsed before use and a method blank is performed with each extraction batch to demonstrate that the extraction system is free of contamination.

Safety Precautions and Waste Handling:

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound and reagent should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means are available such as fume hoods, safety glasses, lab coats, and gloves . Refer to the *Lancaster Laboratories Chemical Hygiene Plan* for specific details.

All solvent waste generated from this analysis must be collected for recycling (if applicable) or must be disposed of in designated containers. These will then be

transferred to a lab-wide disposal facility. Any solid waste material (disposable pipettes, broken glassware, pH paper) must be disposed of in the normal solid waste collection containers or sharps containers, as applicable.

Sample Preservation and Holding Time:

Water samples may be preserved with sodium thiosulfate ($Na_2S_2O_3$) and must be prepared within 7 days of the date collected. Soil samples are not preserved and must be prepared within 14 days of the date collected. Extracts must be analyzed within 40 days of the date extracted.

Extracts must be refrigerated at 2° to 4°C in amber vials.

Apparatus and Equipment:

1. 25-µL syringe

2. Hewlett-Packard Model 5890 (Series I and II) or Hewlett-Packard/Agilent 6890 Gas Chromatograph or equivalent

3. Hewlett-Packard Models 5971, 5972, and Hewlett-Packard/Agilent 5973 Mass Selective Detector or equivalent

4. Thru-Put Systems Target Acquisition Software/Oracle Database or equivalent

Reagents and Standards:

1. 50 ng/µL Solution of decafluorotriphenylphosphine (DFTPP) containing pentachlorophenol, benzidine and DDT, prepared from Absolute Standards, Inc., part # 43030 in methylene chloride or equivalent. Store at 0° - 4°C for up to 6 months.

2. Methylene chloride, pesticide grade. Store at room temperature.

3. Supelco Equity Semivolatile Internal Standard Mix, part # 46955-U or equivalent, 2000 µg/mL in methylene chloride. Ampulated solutions are maintained at <10°C until consumed or manufacturer determined expiration date. Working solution is maintained at room temperature and is replenished daily from ampulated solutions.

4. Calibration Standards – Refer to SOP-EX-001

Procedure:

Refer to the GC/MS Semivolatiles training manual for the specific information on acquiring and processing data.

Internal standard mix is added to all standards and subsequent samples at a concentration of 40 µg/mL. Using a 25-µL syringe, 20 µL of Supelco Equity Semivolatile Internal Standard Mix or equivalent, 2000 ug/mL in methylene chloride are added to the 1 mL of standard or sample extract.

A. Standard preparation – These solutions are used to standardize the GC/MS system every 12 hours and are prepared aproximately every week to 10 days or more frequently if needed based on consumption. See SOP-EX-001 for standard preparation. Calibration standard solutions may be used up to the labeled expiration date or until component degradation is observed.

B. Daily maintenance – Refer to MC-EX-001 for this procedure.

C. Instrument Conditions

Equip a GC/MS (such as referenced under *Apparatus and Equipment) in one of the* two following manners:

For a 5890/5971 or 5972 and 6890/5973

1. Column – 30M x 0.25 mm ID, 1.0 um df, J&W Scientific DB-5MS or equivalent

2. Injector – Split/splitless operated in splitless mode

3. Injector Temp – 275°C

4. Detector Temp – 300°C

5. Gas – Helium at approximately 1.5 mL/min, constant flow mode

6. Oven Temp – 45°C for 3 minutes, ramp at 8°C/minute to 225°C, then ramp at 12°C/minute to 300°C and hold for 7.5 minutes.

For a 6890/5973

1. Column – 20M x0.18 mm ID, 0.18 um df, J&W Scientific DB-5MS or equivalent

2. Injector – Split/splitless operated in split mode, 30:1 split

3. Injector Temp – 275 °C

4. Detector Temp – 280 °C

5. Gas – Helium at approximately 1.0 ml/min, constant flow mode

6. Oven Temp – 40 °C for 1 minute, ramp at 25 °C/minute to 100 °C, then ramp at 30 °C/minute to 280 °C, followed by another ramp at 25 °C/minute to 320 °C, hold for 2 minutes.

Note: It is not necessary to use the exact parameters listed above. Equivalent columns and conditions that give the performance required by the method are acceptable.

D. Tuning

The GC/MS must be tuned using a 50 ng/µL solution of DFTPP containing pentachlorophenol, benzidine, and DDT.

Frequency	Acceptance Criteria	Corrective Action
Every 12 hours	1. Criteria in Table I 2. DDT breakdown ≤20%* 3. Tailing factors: • Benzidine ≤3 • Pentachlorophenol ≤5	1. Retune. Analysis cannot proceed until tune meets criteria. 2. More aggressive injection port maintenance. 3. Clean the source. 4. Change the column.

*__Note:__ DDT breakdown greater than 20 percent may be acceptable if you are calibrating for polynuclear aromatic hydrocarbon compounds only. Consult supervisor when this situation occurs.

1. Use only the background-subtracted spectrum of the following when evaluating the DFTPP:

   a. The apex of the scan

   b. The apex of the scan -1

   c. The apex of the scan +1

   d. A three scan average of the above three scans

   e. A five scan average

NOTE: All standards, samples, and associated quality control samples with a particular tune must use the identical conditions of the mass spectrometer.

2. Calculation of DDT breakdown

$$\%\ DDT\ Breakdown = \frac{DDE\ TIC\ AREA + DDD\ TIC\ AREA}{DDE\ TIC\ AREA + DDD\ TIC\ AREA + DDT\ TIC\ AREA} \times 100$$

Where:

DDE and DDD = The breakdown products of DDT

TIC = Total Ion Chromatogram

E. Initial Calibration

Standardization is performed by analyzing at least six levels of calibration standards ranging from 5 µg/mL to 120 µg/mL. (Refer to SOP-EX-001 for the preparation of calibration standards.) Using the internal standard calibration technique an average relative response factor is generated for each compound. Table 3 lists the six internal standards used for the method and the target compounds that are associated with each internal standard. Refer to the GC/MS Semivolatile Training Manual for more specific information. A method detection limit (MDL) standard must be analyzed with each initial calibration. This standard is prepared at the departmental MDL and is not to be included in the calibration curve. All compounds must be detected in the MDL standard. An initial calibration verification (ICV) standard is also to be analyzed with each initial calibration.

Frequency	Acceptance Criteria	Corrective Action
Initially and then when CCCs and/or SPCCs in the daily calibration standard fail criteria. Initially establish with at least six levels of standards and an MDL standard. See Table 2 for a list of the SPCC and CCC compounds.	1. Ave RRF for each SPCC ≥0.05. 2. %RSD for each CCC ≤30%. 3. %RSD for non-CCCs ≤50%. * 4. All compounds of interest must be detected in the MDL standard. 5. The relative retention times of the target compounds must agree within 0.06 relative retention time units. The exception would be in the case of system maintenance. 6. Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is <25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.	1. Any target analyte with an %RSD of ≤15% should use the average RRF. For any analyte in which the %RSD >15%, use a first degree (linear) fit should be used if the correlation coefficient is ≥0.99. If the CC of the linear fit is <0.99, then a second order (quadratic) fit may be used provided the coefficient of determination is ≥0.99. If both the CC for the linear fit and the CD for the quadratic fit are ≥0.99 for any given analyte, then use the fit with the smallest negative y-intercept. When using a quadratic fit, if the y-intercept quantifies to be greater than the MDL, consult your supervisor immediately or recalibrate. See below for corrective action if the coefficient of determination (COD) for a quadratic fit is <0.99.** 2. If a compound is not detected in the MDL standard, then report to the level of the lowest standard detected. All compounds manually integrated in this standard must be checked for in each sample analyzed under this initial calibration.* 3. More aggressive system maintenance, and recalibrate.

*If these situations occur, your supervisor is to be consulted immediately.

** See USEPA Method 8000B for the calculations associated with non-linear fit types.

With supervisory approval, the following problematic compounds can be allowed to fail the 0.99 coefficient of determination criteria for a quadratic fit:

1,4-Phenylenediamine
4-Aminobiphenyl
3,3'-Dimethylbenzidine
4,4'-Methylenebis(2-chloroaniline)
4-Nitroquinoline-1-oxide
1,4-Naphthoquinone
methapyrilene

If the CD is less than 0.99 for any other compound, the system should be inspected for problems and recalibrated. Supervisory approval is required for exceptions to these guidelines.

F. Continuing calibrations

Frequency	Acceptance Criteria	Corrective Action
1. Every 12 hours. 2. Check standard should be run at alternating concentration levels starting with the standard that is at or near the mid-point of the calibration. The check standard run in the next 12 hour tune should be the concentration level above the mid-point followed by the concnetration level below the mid-point in the subsequent 12 hour tune. The concentration of the check standard will continue to be alternated until a new initial calibration is required, at which point the alternating process starts anew.	1. RRF for each SPCC ≥0.05. 2. %Drift for each CCC ≤20%. 3. %Drift for all non-CCCs ≤50%. * 4. The relative retention times of the target compounds must agree within 0.06 relative retention time units. The exception would be for the case of system maintenance. 5. The EICP area for each internal standard must fall within the window of -50% to +100% from average of the areas produced during the last initial calibration. 6. Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is <25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.	1. If the CCC or SPCC compounds do not meet criteria but all compounds of interest have a %Drift ≤20%, the calibration may be used. ** 2. More aggressive system maintenance or recalibrate

*If these situations occur, your supervisor is to be consulted immediately

**Notification to the data user will occur in the case narrative that is submitted with the data package. Your supervisor must be consulted.

In the event that two consecutive continuing calibration check standards fail for the list of target analytes being quantified, then after the appropriate system maintenance has been performed, two consecutive continuing calibration check standards must pass criteria, before analysis can continue. If the analytical system can not pass two consecutive checks, then the system must be recalibrated.

G. Calibration Calculations:

1. Calculation of the relative response factor (RRF):

$$RRF = \frac{[A(x) \times C(is)]}{[A(is) \times C(x)]}$$

Where:

A(x) = Area of the characteristic ion for the compound being measured

A(is) = Area of the characteristic ion for the specific internal standard

C(x) = Concentration of the compound being measured

C(is) = Concentration of specific internal standard

2. Regression, equations

1st Order (linear) regression: Y = M(X) + B
2nd Order (quadratic) regression: Y = B + M(X) + CX2

Where:

Y = $\frac{\text{Conc Std}}{\text{Conc Istd}}$

X = $\frac{\text{Area Std}}{\text{Area Istd}}$

M = 1st degree slope

C = 2nd degree slope

B = Y intercept

3. Calculation of the percent drift:

$$\%\ Drift = \frac{C(i) - C(c)}{C(i)} \times 100$$

Where:

C(i) = Calibration check compound standard concentration

C(c) = Measured concentration using selected quantification method

4. Calculation of the percent relative standard deviation (%RSD):

$$\%RSD = \frac{SD}{\overline{RF}} \times 100$$

Where:

SD = Standard deviation

$\overline{RF}$ = Average response factor

H. *Qualitative analysis*

A compound is identified by comparison of the following parameters with those of a standard of this suspected compound (standard reference spectra). In order to verify identification, the following criteria must be met:

1. The intensities of the characteristic ions of the compound must maximize in the same scan or within one scan of each other.

2. The sample component relative retention time should compare within ±0.06 RRT units of the RRT of the standard component.

3. The characteristic ions from the reference mass spectrum are defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum.

4. The primary and secondary ions can be found in Table 4.

I. Quantitative analysis

Once a compound has been identified, quantitation will be based on the internal standard technique and the integrated abundance from the extracted ion current profile (EICP) of the primary characteristic ion. The list of primary characteristic ions is listed in Table 4.

Waters:

$$Concentration\ (\mu g/L) = \frac{A(x) \times I(s) \times V(t) \times D_f}{A(is) \times RRF \times V(o) \times V(i)}$$

Where:

A(x)	=	Area of characteristic ion for compound being measured
I(s)	=	Amount of internal standard injected (ng)
V(t)	=	Volume of concentrated extract in microliters (µL)
D_f	=	Dilution factor
A(is)	=	Area of characteristic ion for the internal standard
RRF	=	Relative response factor for the compound being measured
V(j)	=	Volume of extract injected (µL)
V(o)	=	Volume of water extracted (mL)

Soils:

$$Concentration\ (\mu g\ /\ kg) = \frac{A(x) \times I(s) \times V(t) \times G \times D_f}{A(is) \times RRF \times W(s) \times V(i) \times D}$$

Where:

A(x)	=	Area of characteristic ion for compound being measured
I(s)	=	Amount of internal standard injected (ng)
V(t)	=	*Volume of concentrated extract in microliters*
D_f	=	Dilution factor
A(is)	=	Area of characteristic ion for the internal standard
RRF	=	Relative Response factor for the compound being measured
V(i)	=	Volume of extract injected (µL)
W(s)	=	Weight of sample extracted or diluted in grams
D	=	The percent solids (100 - % moisture)/100
G	=	1 if extract did not require GPC cleanup
G	=	2 if extract required GPC cleanup

J. Quality Assurance:

Each extraction batch must contain a *method blank*, a *laboratory control sample* (LCS), and either an unspiked background sample (US), a matrix spike (MS), a matrix spike duplicate (MSD) or a laboratory control sample/laboratory control sample duplicate (LCS/LCSD). Additional QC samples may be required to meet project or state certification requirements.

Quality Control Item	Acceptance Criteria	Corrective Action
Internal Standards	1. Peak area within -50% to +100% of the area in the associated reference standard. 2. Retention time(RT) within 30 seconds of RT for associated reference standard.	1. Check instrument for possible problems and then reanalyze samples. 2. If reinjection meets the criteria, report this injection. 3. If reinjection still shows *same problem, report first* injection and qualify data with a comment.
Method Blank	1. Must meet internal standard criteria. 2. Must meet surrogate criteria. 3. All target compounds must be less than the reporting limit for the associated samples.	1. Inspect system for possible problems and reanalyze. 2. If one surrogate is out of spec high and all associated sample surrogates are in spec, data can be used. (Unless project requirements dictate otherwise). * 3. If the method blank contains target analytes and the associated samples do not contain these compounds, no corrective action is required. If the target compounds in the blank are also in the associated samples, the samples should be reextracted unless it does not interfere with project data requirements.
Laboratory Control Sample/Laboratory Control Sample Duplicate	All percent recoveries within QC limits. Refer to the GC/MS Semivolatile SOP manual for QC windows. These are reviewed on a semiannual basis and updated annually.	1. If non-compliant, check for calculation or preparation errors. 2. If no errors found, check system for problems and reanalyze. 3. If LCS/LCSD still out of spec, consult supervisor immediately. Samples may need to be re-extracted.

Quality Control Item	Acceptance Criteria	Corrective Action
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	1. % Recoveries within QC limits. Refer to the GC/MS Semivolatile SOP manual for QC windows. These are reviewed on a semiannual basis and updated annually. 2. RPDs within QC limits.	1. If LCS within QC limits, proceed with sample analysis. 2. If most recoveries or RPDs out of spec, consult supervisor.
Surrogates	All recoveries must be within QC limits. Refer to the GC/MS Semivolatile SOP manual for surrogate windows. These are updated on a semiannual basis.	1. If non-compliant, check for calculation or preparation errors. 2. If no errors found, check system for problems and reanalyze. 3. If no problem is found, reextract and reanalyze the sample.

* Requires approval of supervisor and completion of Non-Conformance Form #2586.

K. Dilution Criteria

1. Initial Dilutions:

   a. More than three internal standard areas are less than -50%.

   b. Either of the last two internal standard areas are less than -80%.

   c. Prescreen data or analyst's judgement of a sample extract's color or viscosity, indicate a possible matrix interference.

2. Secondary Dilutions:

   Are required to bring all target compounds in the calibration range of the GC/MS.

L. QC Calculations

Percent Recovery:

$$\%Recovery = Concentration\ found \div Concentration\ spiked \times 100$$

Calculations for MS/MSD:

$$Matrix\ spike\ recovery = SSR \times SR \div SA \times 100$$

Where:

SSR = Spike sample result

SR = Sample result

SA = Spike added

Relative Percent Difference (RPD)

$$RPD = \left\{\left|MSR \times MSDR\right| \div \tfrac{1}{2}\left(MSR \times MSDR\right)\right\} \times 100$$

Where:

RPD = Relative percent difference

MSR = Matrix Spike Recovery

MSDR = Matrix Spike Dup Recovery

Revision Log:

Ver. #	Effective Date	Change
00	07/03/95	Previous issue
01	07/07/97	Major changes are as follows: • Added section on Personnel Training and Qualifications • Updated method references • Deleted Additional TCLP Requirements section • Removed QC Windows from tables
02	03/11/99	Major changes are as follows: • Changed method number from Analysis #0949, 0968, 1198, 1199, 1200, 1309, 1310, 1311, 1312, 1424, 1425, 1426, 4688, 4689, 4678, 4679, 4615, 4616, 4617, 4618, 3349, 7820, 7821, 7822, 7823, 7804, 7805, 5749, 5750, 7357, 7358, 7437, 7438, 7588, 7589 to Analysis #0949, 0968, 1198, 1199, 1200, 1309, 1310, 1311, 1312, 1424, 1425, 1426, 4688, 4689, 4678, 4679, 4615, 4616, 4617, 4618, 3349, 7820, 7821, 7822, 7823, 7804, 7805, 5749, 5750, 7357, 7358, 7437, 7438, 7588, 7589, 7804, 7805 • Changed title • Made changes to Reference section • Made changes to Procedure C., Standardization

Ver. #	Effective Date	Change
03	05/17/01	Major changes are as follows: • Removed analysis # 3349, 7820, 7821, 7822, 7823, 5749, 5750, 7357, 7358, 7437, 7438, 7588, 7589 • Added the use of the 25-uL syringe for internalization of standards and sample extracts • Inserted Procedure C., Instrument Conditions • Added cross-reference to Method 8000B for non-linear calibration calculations • Added Table 3 (List of compounds and associated internal standard • Added Table 4 (List of compounds with primary and secondary characteristic ions.
04	DEC 3 0 2004	Major changes are as follows: • Updated to level 3 • Added the following sections: Interferences; Sample Preservation and Holding Time; • Added Waste Handling to the Safety Precautions section. • Incorporated PA's #1 through #4 • Added ICV to initial calibration section • Added alternating concentration levels to continuing calibration section

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Prepared by: _____ Date: 12/29/04
Group Leader I

Approved by: _____ Date: 12/29/04
GC/MS Semivolatiles Management

Approved by: _____ Date: 12/30/04
Quality Assurance

Table 1

DFTPP Key Ions and Ion Abundance Criteria

Mass	Ion Abundance Criteria
51	30% to 60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40% to 60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5% to 9% of mass 198
275	10% to 30% of mass 198
365	>1% of mass 198
441	Present but less than mass 443
442	>40% of mass 198
443	17% to 23% of mass 442

Table 2

CCCs

Acenaphthene
1,4-Dichlorobenzene
Hexachlorobutadiene
Diphenylamine*
Di-n-octylphthalate
Fluoranthene
Benzo(a)pyrene
4-Chloro-3-methylphenol
2-Nitrophenol
Phenol
Pentachlorophenol
2,4,6-Trichlorophenol

Note: Diphenylamine cannot be separated from N-nitroso-di-phenylamine under the chromatographic conditions used for sample analysis.

SPCCs

N-Nitroso-di-n-propylamine
Hexachlorocyclopentadiene
2,4-Dinitrophenol
4-Nitrophenol

Table 3

SEMIVOLATILE INTERNAL STANDARD WITH CORRESPONDING ANALYTES ASSIGNED FOR QUANTITATION

1,4-Dichlorobenzene-d_4	Naphthalene-d_8	Acenaphthene-d_{10}
Aniline	Acetophenone	Acenaphthene
Benzyl alcohol	Benzoic acid	Acenaphthylene
Bis(2-chloroethyl) ether	Bis(2-chloroethoxy)methane	1-Chloronaphthalene
Bis(2-chloroisopropyl) ether	4-Chloroaniline	2-Chloronaphthalene
2-Chlorophenol	4-Chloro-3-methylphenol	4-Chlorophenyl phenyl ether
1,3-Dichlorobenzene	2,4-Dichlorophenol	Dibenzofuran
1,4-Dichlorobenzene	2,6-Dichlorophenol	Diethyl phthalate
1,2-Dichlorobenzene	α,α-Dimethylphenylamine	Dimethyl phthalate
Ethyl methanesulfonate	2,4-Dimethylphenol	2,4-Dinitrophenol
2-Fluorophenol (surr)	Hexachlorobutadiene	2,4-Dinitrotoluene
Hexachloroethane	Isophorone	2,6-Dinitrotoluene
Methyl methanesulfonate	2-Methylnaphthalene	Fluorene
2-Methylphenol	Naphthalene	2-Fluorobiphenyl (surr)
4-Methylphenol	Nitrobenzene	Hexachlorocyclopentadiene
N-Nitrosodimethylamine	Nitrobenzene-d5 (surr)	1-Naphthylamine
N-Nitroso-di-n-propyl amine	2-Nitrophenol	2-Naphthylamine
Phenol	N-Nitrosodi-n-butylamine	2-Nitroaniline
Phenol-d6 (surr)	N-Nitrosopiperidine	3-Nitroaniline
2-Picoline	1,2,4-Trichlorobenzene	4-Nitroaniline
1,4-Dioxane	1-Methylnaphthalene	4-Nitrophenol
Pyridine	O,O,O-triethylphosphorothioate	Pentachlorobenzene
Acetophenone	Hexachlorpropene	1,2,4,5-Tetrachlorobenzene
o-Toluidine	1,4-Phenylenediamine	2,3,4,6-Tetrachlorophenol
N-Nitrosomethylethylamine	Safrole	2,4,6-Tribromophenol (surr)
N-Nitrosodiethylamine	(2-Bromoethyl)benzene	2,4,6-Trichlorophenol
N-Nitrosopyrrolidine	Caprolactam	2,4,5-Trichlorophenol
N-Nitrosomorpholine	1, 3, 5 – Trichlorobenzene	1,1'-Biphenyl
N,N-dimethyl formamide	1, 2, 3 – Trichlorobenzene	Diphenyl ether
N,N-dimethyl acetamide	1, 2, 3, 4 – Tetrachlorobenzene	Isosafrole
Benzaldehyde	1 – Chloro-4-Nitrobenzene	1,4-Naphthoquinone
		1,4-Dinitrobenzene
		1,3-Dinitrobenzene
		Thionazin
		5-Nitro-o-toluidine

(surr) = surrogate

Table 3 (continued)

Phenanthrene-d_{10}	Chrysene-d_{12}	Perylene-d_{12}
4-Aminobiphenyl	Benzidine	Benzo(b)fluoranthene
Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene
4-Bromophenyl phenyl ether	Bis(2-ethylhexyl) phthalate	Benzo(g,h,i)perylene
Di-n-butyl phthalate	Butyl benzyl phthalate	Benzo(a)pyrene
4,6-Dinitro-2-methylphenol	Chrysene	Dibenz(a,j)acridine
Fluoranthene	3,3'-Dichlorobenzidine	Dibenz(a,h)anthracene
Hexachlorobenzene	p-Dimethylaminoazobenzene	Indeno(1,2,3-cd)pyrene
N-Nitrosodiphenylamine	Pyrene	Di-n-octylphthalate
Pentachlorophenol	*Terphenyl-d_{14} (surr)*	3-Methylcholanthrene
Pentachloronitrobenzene	7,12-Dimethylbenz(a)anthracene	
Phenacetin	Chlorobenzilate	
Phenanthrene	2-Acetylaminofluorene	
Pronamide	3,3'-Dimethylbenzidine	
1-Nitronaphthalene	4,4'-Methylenebis(2-Chloroaniline)	
1,2-Diphenylhydrazine		
Carbazole		
Tetraethyldithiopyrophosphate		
1,3,5-Trinitrobenzene		
Diallate trans/cis		
Phorate		
Dimethoate		
Methyl parathion		
Parathion		
4-Nitroquinoline-1-oxide		
Methapyrilene		
Isodrin		
Atrazine		

(surr) = surrogate

Table 4

CHARACTERISTIC IONS FOR SEMIVOLATILE COMPOUNDS

Compound	Primary Ion	Secondary Ions
2-Picoline	93	66,92
Aniline	93	66,65
Phenol	94	65,66
Bis(2-chloroethyl) ether	93	63,95
2-Chlorophenol	128	64,130
1,3-Dichlorobenzene	146	148, 113
1,4-Dichlorobenzene-d_4 (IS)	152	150,115
1,4-Dichlorobenzene	146	148, 113
Benzyl alcohol	108	79,77
1,2-Dichlorobenzene	146	148, 113
N-Nitrosomethylethylamine	88	42,43,56
Bis(2-chloroisopropyl) ether	45	77, 121, 79
Methyl methanesulfonate	80	79,65,95
N-Nitrosodi-n-propylamine	70	42,101,130
Hexachloroethane	117	201,199
Nitrobenzene	77	123,65
Isophorone	82	95,138
N-Nitrosodiethylamine	102	42,57,44,56
2-Nitrophenol	139	109,65
2,4-Dimethylphenol	107	122, 121
Bis(2-chloroethoxy)methane	93	95,123
Benzoic acid	105	122,77
2,4-Dichlorophenol	162	164,98
Ethyl methanesulfonate	109	79,97,45,65
1,2,4-Trichlorobenzene	180	182,145
Naphthalene-d_8 (IS)	136	68
Naphthalene	128	129,127
Hexachlorobutadiene	225	223,227
4-Chloro-3-methylphenol	107	144,142
2-Methylnaphthalene	142	141, 115
2-Methylphenol	108	107,77,79,90
Hexachloropropene	213	211, 215, 117, 141
Hexachlorocyclopentadiene	237	235,272
N-Nitrosopyrrolidine	100	41,42,68,69
Acetophenone	105	71,51,120
4-Methylphenol	108	107,77,79,90
2,4,6-Trichlorophenol	196	198,200

Table 4 (continued)

Compound	Primary Ion	Secondary Ions
o-Toluidine	106	107,77,51,79
3-Methylphenol (as 4-Methylphenol)	108	107,77,79,90
2-Chloronaphthalene	162	127,164
N-Nitrosopiperidine	114	42,55,56,41
1,4-Phenylenediamine	108	80,53,54,52
1-Chloronaphthalene	162	127,164
2-Nitroaniline	138	92, 65
Dimethyl phthalate	163	194,164
Acenaphthylene	152	151,153
2,6-Dinitrotoluene	165	63,89, 121
Phthalic anhydride	104	76,148
3-Nitroaniline	138	108,92
Acenaphthene-d_{10} (IS)	164	162,160
Acenaphthene	153	154, 152
2,4-Dinitrophenol	184	63, 154, 107
2,6-Dinitrophenol	162	164,126,98,63
4-Chloroaniline	127	129,65,92
Isosafrole	162	131,104,77,51
Dibenzofuran	168	139
2,4-Dinitrotoluene	165	63,89, 182
4-Nitrophenol	109	139,65
2-Naphthylamine	143	115,116
1,4-Naphthoquinone	158	104,102,76,130
Diethyl phthalate	149	177,150
Fluorene	166	165,167
N-Nitrosodi-n-butylamine	84	57,41,116,158
4-Chlorophenyl phenyl ether	204	206,141
4,6-Dinitro-2-methylphenol	198	51, 105, 182, 77
N-Nitrosodiphenylamine	169	168,167
Safrole	162	104,77,103,135
Diphenylamine	169	168,167
1,2,4,5-Tetrachlorobenzene	216	214,179,143,218
1-Naphthylamine	143	115,89,63
4-Bromophenyl phenyl ether	248	250,141
2,4,5-Trichlorophenol	196	198,97,132,200
Hexachlorobenzene	283	142,249
Pentachlorophenol	266	264,268
5-Nitro-o-toluidine	152	77,79,106,94
Thionazin	107	96,97,143,79

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Table 4 (continued)

Compound	Primary Ion	Secondary Ions
4-Nitroaniline	138	65,108,92,80
Phenanthrene-d_{10} (IS)	188	94,80
Phenanthrene	178	179,176
Anthracene	178	176,179
1,4-Dinitrobenzene	168	75,50,76,92
1,3-Dinitrobenzene	168	76,50,75,92
Diallate (cis or trans)	86	234,43,70
Pentachlorobenzene	250	252,248,215,254
5-Nitro-o-anisidine	168	79,52,138,153,77
Pentachloronitrobenzene	237	142,214,249,295
4-Nitroquinoline-1-oxide	190	160, 116, 114
Di-n-butyl phthalate	149	150,104
2,3,4,6-Tetrachlorophenol	232	131,230,166,234
Fluoranthene	202	101, 203, 100
1,3,5-Trinitrobenzene	213	74,75,120,91
Benzidine	184	92,185
Pyrene	202	101,203
Phorate	75	121,97,93,260
Phenacetin	108	179,109,137,80
Dimethoate	87	93,125,143,229
4-Aminobiphenyl	169	168,170,115
Pronamide	173	175,145,109,147
Dinoseb	211	163,147,117,240
Disulfoton	88	97,89,142,186
Butyl benzyl phthalate	149	91,206
Methyl parathion	109	125,263,79,93
Dimethylaminoazobenzene	225	120,77,148,42
Benz(a)anthracene	228	229,226
Chrysene-d_{12} (IS)	240	120,236
3,3'-Dichlorobenzidine	252	254,126
Chrysene	228	226,229
Parathion	109	97,291, 186
Bis(2-ethylhexyl) phthalate	149	167,279
3,3'-Dimethylbenzidine	212	106,196,180
Methapyrilene	97	58. 72, 191, 261
Isodrin	193	66, 195. 263, 265,
Di-n-octyl phthalate	149	167,43, 150
2-Aminoanthraquinone	223	167. 195, 139
Aramite	185	191,319,334,197.321

Table 4 (continued)

Compound	Primary Ion	Secondary Ions
Benzo(b)fluoranthene	252	253,125
Benzo(k)fluoranthene	252	253,125
Chlorobenzilate	139	251, 253, 111, 141
Benzo(a)pyrene	252	253,125
Perylene-d_{12} (IS)	264	260,265
7,12-Dimethylbenz(a)anthracene	256	241,239,120
2-Acetylaminofluorene	181	180,223,152
4,4'-Methylenebis(2-chloroaniline)	231	266, 140, 195
3-Methylcholanthrene	268	252,253,126,134
Indeno(1,2,3-cd)pyrene	276	138,227
Dibenz(a,h)anthracene	278	139,279
Benzo(g,h,i)perylene	276	138,277
1,2-Diphenylhydrazine	77	105, 182, 51
Endosulfan I	195	33
2-Fluorobiphenyl (surr)	172	171
2-Fluorophenol (surr)	112	*64, 92*
Nitrobenzene-d_5 (surr)	82	128,54
N-Nitrosodimethylamine	74	42,44
Phenol-d_6 (surr)	99	42,71
Terphenyl-d_{14} (surr)	244	122,212
2,4,6-Tribromophenol (surr)	330	332,141
N,N-dimethyl formamide	73	44,42
N,N-dimethyl acetamide	87	72,44,42
(2-Bromoethyl)benzene	184	77,91,105,186
Atrazine	200	173,215
Benzaldehyde	77	105, 106
Caprolacatam	113	55,56
1,1-Biphenyl	154	153,152,76
Carbazole	167	166,139
1,3,5-Trichlorobenzene	180	182,145,109
1,2,3-Trichlorobenzene	180	182,145,109
1,2,3,4-Tetrachlorobenzene	216	214,218,179
1-Chloro-4-Nitrobenzene	157	111,75,99

IS = internal standard
surr = surrogate

LABORATORY OPERATIONS MANUAL – ENVIROMENTAL SCIENCES SECTION
Internal Chain-of-Custody Documentation

Table of Contents

Approvals

Prepared by: Barbara F. Reedy — Senior Specialist — Date: 3/8/05

Approved by: Dorothy M Kline — Quality Assurance Management — Date: 3/8/05

Approved by: [signature] — Executive Management — Date: 3/9/05

Revision Log:

Ver. #	Effective Date	Change
		Previous Issue: SOP-QA-104.05
01	02/20/03	Major changes are as follows: • Removed Pharmaceutical information • Updated to LOM-SOP format • Minor clarifications throughout • Updated Figure 3 and 5
02	MAR 2 3 2005	Major changes are as follows: • Updated Cross Reference section • Clarified Procedure section A Initial documentation • Updated Figures 2, 4, and 5 • Incorporated Procedural Amendment

LOMSOPES112_02.DOC
030705

Reference:

Quality Policy Manual, Lancaster Laboratories, Inc., current version.

Cross Reference:

Document	Document Title
LOM-SOP-LAB-220	Laboratory Notebooks, Logbooks, and Documentation
Form 2016	Secure Storage Chain of Custody Original Sample
Form 2102	Analysis Request/Environmental Service Chain of Custody
Form 2174	Sample Administration Receipt Documentation Log
Form 2231	Secure Storage Chain of Custody, Metals
Form 2365	Master List of Chains of Custody
Form 2667	Sample Storage, Off-Shift Entry Logbook

Purpose:

In order to demonstrate reliability of data which may be used as evidence in a legal case, required by a regulatory agency, or required by a client, an accurate written record tracing the possession of samples must be maintained from the time they are received at the laboratory until the last requested analysis is verified. The purpose of a chain of custody (COC) is to ensure traceability of samples while they are in the possession of the laboratory.

Scope:

This procedure describes the initiating and maintaining of COC documentation for samples that require this level of traceability. It applies to the Environmental Division of Lancaster Laboratories when a client or regulatory agency requests an accurate written record tracing the possession of samples from the time they are received at the laboratory until the last requested analysis is verified. This procedure also applies to samples that may be used as evidence in a legal case.

Definitions:

A sample is in custody if it is in any one of the following states:

1. In actual physical possession
2. In view after being in physical possession.
3. Locked up so no one can tamper with it.
4. In a secured area, restricted to authorized personnel (e.g., in the ASRS).

Personnel Training and Qualifications:

Training for this procedure consists of reading this SOP. Supervisory review of all COC documentation should be done until the trainer is satisfied that proficiency has been achieved. Training of all laboratory personnel is the responsibility of the group leader. Documentation that this training has been completed must be kept in the employee's training record.

Procedure:

A. Initial documentation

1. Chain-of-custody documentation shall be kept upon the request of the client or for any samples that are known to be involved in a legal dispute. As with all analytical data, it is extremely important that this documentation is filled out completely and accurately with every sample transfer. Everyone who handles the COC is responsible to check for documentation compliance to the point of their acquisition. If changes need to be made to the form, they shall be made in accordance to the error correction procedure addressed in LOM-SOP-LAB-220 It is the responsibility of the person who made an error in documentation to correct the error.

2. If requested by the client, the COC documentation will begin with the preparation of sampling containers. Form 2102 will be initiated by the person packing the bottle order for shipment to the client. If the delivery of containers is via Lancaster Laboratories Transportation department, the SCR # (Form 2102, section 6) will be utilized to track the person preparing the bottles order. The Lancaster Laboratories' *driver will sign Form 2102, section 9 when they relinquish the bottles to the client.* Drivers must also sign COC forms when they pick up samples from the client for transportation to the laboratory.

3. When samples arrive at the laboratory for analysis, a member of the Sample Administration group will receive them and sign the external COC form that accompanies the samples, if provided. If the samples were picked up by our Transportation department, the driver must sign the COC to relinquish the samples to Sample Administration.

4. The Sample Administration group will track the custody of samples between receipt and entry into the CSMS on Form 2174 (Figure 2). The client's sample designation will be used for identification purposes until a unique Lancaster Laboratories number is assigned.

5. Samples will be entered into the Sample Management System as described in *Quality Policy Manual.* Sample Administration will enter an analysis number for "Laboratory Chain of Custody" if requested. A lab note will print to inform analysts of the need for COC documentation. This note will also be automatically added to the sample labels.

B. Creating the internal COC

1. Sample Administration personnel shall initiate an internal Laboratory Chain of Custody Form 2016 (Figure 3) at the time of sample entry for each type of container in the sample group. Form 2365 will be initiated for each sample group at the time of entry (Figure 4). The samples will then be relinquished to a sample custodian who will store the samples in an assigned secure location. This change of custody from sample entry to storage shall be documented on the chain, as well as any interim exchanges for rush analysis, preservation, homogenization, or temporary storage in the SA HOLD. The internal COC forms will then accompany the samples from storage to the laboratory for analysis.

2. If samples need to be checked out from the Sample Administration group, for rush or short hold time analyses, before Lancaster Laboratories numbers have been assigned to them, SA is responsible for starting a COC form. They will note the available header information, the samples being relinquished (documented by the client sample designation), and the reason for transfer.

3. After sample entry, the original copy of the external client COC/analysis request form will be filed with Accounts Receivable, to be returned to the client with their invoice. Other copies of the external form will stay within SA to be filed within the client's paperwork file.

C. Documentation of custody changes

1. An example of how to document changes in sample custody is shown in Figures 3 and 5. Each change of sample custody must be accurately documented in a consistent format. All signatures documenting changes of custody will use the following format:

   Signatures: First initial, full last name, employee number
   Date: Month/day/year
   Time: Documented as military time
   Ink: Black ink is preferred, red ink and pencil are not acceptable

   a. When Sample Support releases samples to an analyst they must:

      Note the sample number(s) released and sign the "Released By" column of the chain.

   b. When an analyst receives samples from Sample Support they must:

      Sign the "Received By" column, note the date and time samples are received, and note the reason why they are taking the samples (reason for change of custody).

   c. When an analyst returns samples to Sample Support they must:

Note all sample numbers being returned, sign the Released By column, and note time and date of return.

d. When Sample Support receives samples from an analyst they must:

Sign the Received By column and note the reason for sample transfer.

2. Sample handling should be kept to a minimum. Analysts requiring use of a sample will requisition it through the computer requisition program. During the hours when Sample Support is staffed by sample custodians, a custodian will receive the computerized requisition and remove the sample from storage. The custodian will ensure that the bottle type listed on the COC form matches the bottle type being distributed. It is the shared responsibility of the analyst and sample custodian to ensure that forms are signed, dated, and that the reason for sample transfer are recorded with each change of custody, as directed by Item (3) a. above.

3. Each specific test that an analyst performed in conjunction with the associated sample number(s) must be accurately documented by the analyst before the samples are returned to a sample custodian in the sample storage area.

4. When an analyst requires the use of samples when a sample custodian is not on duty, they must requisition samples earlier in the day or on the previous day. These samples and associated COCs will be pulled by a sample custodian and placed in the locked Main Storage area. The sample custodian will note on the COC the change in transfer to the Main Storage in addition to the time, date, and the sample numbers. When an analyst picks up the sample from Main Storage, they will need to contact the security person on duty to unlock the Main Storage unit. The analyst will need to fill out Form 2667 (Figure 6) which will be located by the entrance to the Main Storage unit to document entry into the storage unit (security will co-sign as a witness). Once the notebook is signed, the analyst may enter and retrieve their samples. The analyst picking up the samples will document the specific samples being checked out. The security person will sign in the Released By column. The analyst will sign the Received By column, note the time, date, and reason for transfer. When the analyst returns the samples to the Main Storage, security must be contacted. The logbook must be signed by the analyst and security, the analyst must sign the Released By column, and security must sign the Received By column indicating the time, date, and reason for transfer (e.g., Main Storage).

5. The following changes of custody will be handled as noted below:

a. Documentation is required for all shift changes. Signatures involving transfers from one shift to another shall be the responsibility of the analyst who originally acquired the samples from Sample Support

b. Occasionally, a sample container will be needed for analysis by an analyst in a department while it is in the custody of an analyst in another department. It will be the responsibility of the first person who received the sample to note on the COC the specific sample numbers requested by the second person and to sign

the Released By column. The second person will sign the Received By column and note the time, date, and reason for sample transfer. After the second person is finished with the sample, the sample will be returned back to the first person or to the Sample Storage area.

c. In situations where a sample group must be split between departments working on different analyses, a supplemental COC must be initiated by the Sample Support Group. The supplemental chain will be used to accompany that portion of the sample group that is needed by a second department, when another department has part of the sample group and the COC for the entire group. This supplemental COC will be created only when absolutely necessary to minimize paperwork and confusion. This chain must also be documented on the master list of chains initiated for the sample group.

d. If COC samples are stored in other areas of the laboratory or in a specific department, they must be stored in a secured area. When samples are taken *from a departmental storage area, the Released By column of the COC is* documented as "department XX storage." If samples are returned to this area when complete, the Received By column will be noted as department XX storage.

D. Additional COC issues

1. Analysts in possession of samples shall remove the aliquot required for their analysis and return the samples to the Sample Support Group with a minimum of delay. During this time of possession, samples must fall under the definition of sample custody.

2. If additional containers of the sample are created (e.g., subsamples, extracts, distillates, leachates, digests, etc.), then additional COC form must be created by the department if they do not document this information on the original COC form. This form will be marked with the container type and will be initiated to accompany the new sample container. Each department in the lab has specifically designed COC forms that will be used if new containers are created, (see Figure 5 for an example). All changes of custody involving handling of new containers in the department (e.g., **analysis, storage, vials on** instruments, etc.) will be documented on the departmental specific COC form or on the original COC form. Any specific handling or documentation requirements for departmental chains can be described in a departmental SOP.

E. Completion of the process

1. After sample analysis, samples shall be returned to the Sample Support Group as soon as possible. Original COC forms shall also be returned with the samples and this change of custody noted. At this time, it is the responsibility of the Sample Support Group to review the COC forms to ensure that all documentation on the forms is complete before they file the forms in their area. Sample custodians will not return a sample to its assigned storage location without signing the accompanying chain and performing this completeness check. All chains should either end with a note of "All Sample Consumed," "Discard," or "Storage" for the final reason of transfer.

2. All completed COC forms for the original sample containers will be retained in files within Sample Support. The Data Deliverables Group will retrieve these forms so a copy can be included in the data package. (**NOTE:** For those employees who collect COC forms for data packages; if you find a completed COC form in your area that does not get a data package, please send that COC form to the project manager for that account. The project manager will determine whether copies of the COCs get sent to the client with the reports or whether the originals will be archived at Lancaster Laboratories. The project manager will then forward the original COC forms to the Data Deliverables Department for archiving). All departmental created COC forms are collected by the department's data package group so that a copy can be included in the data package. These forms will not be returned to the Sample Support Group since these sample containers will not be returned to the Sample Support Group. The original copy of all COC forms will be retained on file by the laboratory.

3. All personnel who handle sample containers shall make every attempt to ensure that all changes of custody are accurately and completely documented. Disciplinary action may be taken for employees who fail to comply with these important requirements.

4. In the event that a signature or other information is inadvertently not recorded on a COC form, then Sample Support, Data Package Groups, in conjunction with the technical groups, shall determine what information is missing. This can be performed by checking computer requisition records, raw data, or the Sample Support work schedule. The responsible party shall add the missing information or make the necessary correction at the bottom of the COC form, in addition to noting the situation that caused the error in documentation. The person making this note needs to sign and date the information using the current date. Any errors in COC documentation that cause noncompliances must be noted in the case narrative of the sample data package. Examples of specific cases are on file in the Data Deliverables Department.

Figure 1

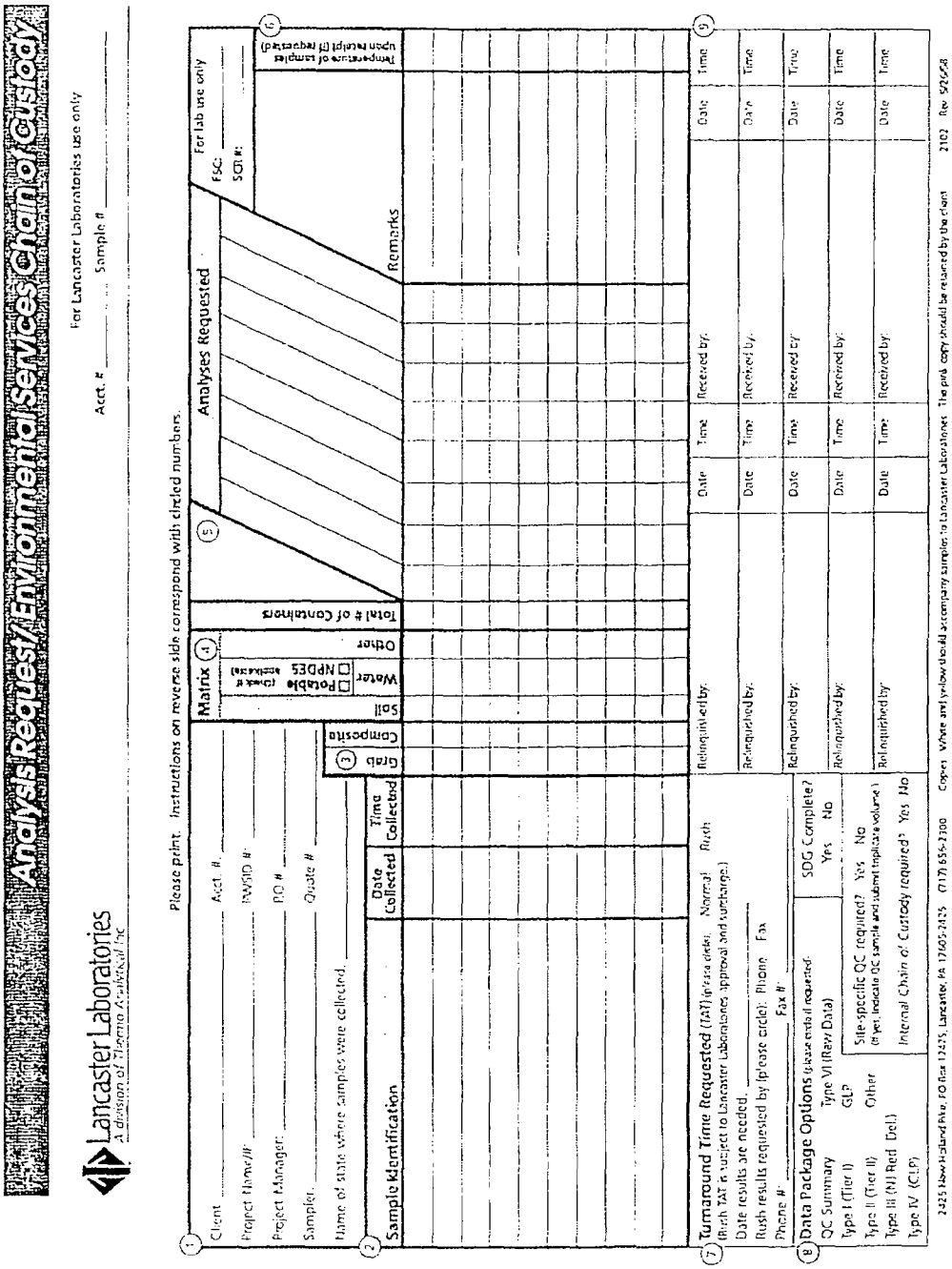

Analysis Request/Environmental Services Chain of Custody
Lancaster Laboratories
A division of Thermo Analytical Inc.
For Lancaster Laboratories use only
Acct. #
Sample #
Please print. Instructions on reverse side correspond with circled numbers.
Client
Acct. #
Project Name/#
PWSID #
Project Manager:
PO #
Sampler:
Quote #
Name of state where samples were collected:
Sample Identification
Date Collected
Time Collected
Grab
Composite
Matrix
Soil
Water
Potable (check if applicable)
NPDES
Other
Total # of Containers
Analyses Requested
Remarks
For lab use only
FSC:
SCR #:
Temperature of samples upon receipt (if requested)
Turnaround Time Requested (TAT) (please circle): Normal Rush
Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed:
Rush results requested by (please circle): Phone Fax
Phone #
Fax #:
Data Package Options (please email if requested)
QC Summary
Type I (Tier I)
Type II (Tier II)
Type III (NJ Red Del)
Type IV (CLP)
Type VI (Raw Data)
CLP
Other
SDG Complete?
Yes No
Site-specific QC required? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes No
Relinquished by:
Received by:
Date
Time
2425 New Holland Pike, PO Box 12425, Lancaster, PA 17605-2425 (717) 656-2300
Copies: White and yellow should accompany samples to Lancaster Laboratories. The pink copy should be retained by the client.
2102 Rev. 9/26/03

Figure 1 – Continued

DIRECTIONS FOR COMPLETING THIS FORM

(1) **Client:** Your company's name
Acct. #: Your account number with Lancaster Laboratories
Project Name/#: The way your company refers to the work involved with these samples. You may want to include project location as part of the description
PWSID: Potable Water Source ID#
Project Manager: The person at your company responsible for overseeing the project
P.O.#: Your company's purchase order number
Sampler: The name of the person who collected the samples
Quote #: The reference number that appears on your quote (if Lancaster Laboratories gave you a number)
State where sample was collected: Please indicate where the sample was taken, e.g., PA, NJ, etc.

(2) **Sample Identification:** The unique sample description you want to appear on the analytical report
Date Collected/Time Collected: When the sample was collected

(3) **Grab:** Check here if sample was taken at one time from a single spot.
Composite: Check here if samples were taken from more than one spot, or periodically, and combined to make one sample.

(4) **Matrix:** Check the type of sample you are submitting. If it is a water sample, please indicate if it is a potable water or if it is an NPDES sample.
Number of Containers: Indicate the total number of containers for each sampling point

(5) **Analyses Requested:** Write the name of each analysis (or an abbreviation of it) here, and use the **catalog number** that appears at the beginning of each line in the *Schedule of Services*. Be sure to indicate which analyses are to be performed on which samples.

(6) **Remarks:** List special instructions about the sample here (e.g., hazardous elements, high levels of analyte, etc.) The space can also be used (if needed) for listing additional analyses

(7) **Turnaround Time Requested:** *Circle* **Normal** if you want routine TAT which is usually within 10-15 days. If you need your results faster, call ahead to schedule **Rush** work

Rush Results Requested by Circle **Fax** or **Phone** and include the number

(8) **Data Package Options:** Call our Client Services Group (717-656-2300) if you have questions about these choices
SDG Complete? Indicate **Yes** if this is a complete sample delivery group or **No** if you will be submitting additional samples to be included in the same data package
Note: We need to have one quality control (QC) sample for every 20 samples you send, if you are requesting site-specific QC. Please give us this sample in triplicate volume and identify it by writing "QC" in the **Remarks** column.
The internal chain of custody is a hand-to-hand documentation recording a sample's movement throughout the company. We routinely start a chain of custody for data package samples unless we are told otherwise. There is a **$25 per sample** charge for the chain-of-custody documentation

(9) **Relinquished by/Received by:** The form must be signed each time the sample changes hands. We can supply chain-of-custody seals for the outside of your packages if you require them

Thank you for using Lancaster Laboratories.
Please call our Client Services Group (717-656-2300) if you have any questions about completing this form.

Figure 2

Lancaster Laboratories
2425 New Holland Pike • Lancaster PA 17601

Environmental Sample Administration
Receipt Documentation Log

Client/Project: _____ Shipping Container Sealed: Y / N

Date of Receipt: _____ Custody Seal Present: Y / N

Time of Receipt: _____ Custody Seal Intact: Y / N / NA

Source Code: _____ Package: Chilled / Not Chilled

Unpacker Emp. No.: _____

Temperature of Shipping Containers	
#1	#2
Thermometer ID: _____	Thermometer ID: _____
Temp.: _____	Temp.: _____
Temp. Bottle / Surface Temp.	Temp. Bottle / Surface Temp.
Wet Ice / Dry Ice / Ice Packs	Wet Ice / Dry Ice / Ice Packs
Ice Present? Y / N Loose / Bagged	Ice Present? Y / N Loose / Bagged
#3	#4
Thermometer ID: _____	Thermometer ID: _____
Temp.: _____	Temp.: _____
Temp. Bottle / Surface Temp.	Temp. Bottle / Surface Temp.
Wet Ice / Dry Ice / Ice Packs	Wet Ice / Dry Ice / Ice Packs
Ice Present? Y / N Loose / Bagged	Ice Present? Y / N Loose / Bagged

Paperwork Discrepancy/Unpacking Problems: _____

_____

_____

_____

Sample Administration Internal Chain of Custody			
Name	Date	Time	Reason for Transfer
			Unpacking
			Place in Storage or Entry
			Remove from Storage
			Place in Storage or Entry
			Entry

2174.01

Figure 3

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

Secure Storage Chain of Custody
Original Sample

Client/Project: ABC Corporation

Preservative: none Matrix: water SDG: ABC01

Sample # Range of Entry Group: 1234567-70 Bottle Type: 05

Sample Number(s) in Custody	Released By	Received By	Date of Transfer	Time of Transfer	Reason for Change of Custody	Dist., Extr., or Digest Chain Created (X)
1234567, 69	I. Keepit/123	M. Chemist/456	2/3/03	0830	BOD analysis	
1234567, 69	M. Chemist/456	I. Keepit/123	2/3/03	1215	storage	X

2016.01

Figure 4

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

Master List of Chains of Custody

Client/Project: _____

Sample # Range of Entry Group: _____

SDG: _____ Matrix: Liquid Solid Mixed Other _____

Original Sample Chains		
Bottle Type	Started By	Date Started

Supplemental Chains		
Bottle Type	Started By	Date Started

Extraction, Digestion, Distillates, Etc.		
Bottle Type	Started By	Date Started

2365.01

Figure 5

Lancaster Laboratories

Secure Storage Chain of Custody
Metals

Client/Project: ABC Corporation

Sample #: 1234568, 70 SDG: ABCØ1

Digest Type (circle one): (Hg) Metals GF Trial No. _____ (If not 1, fill in)

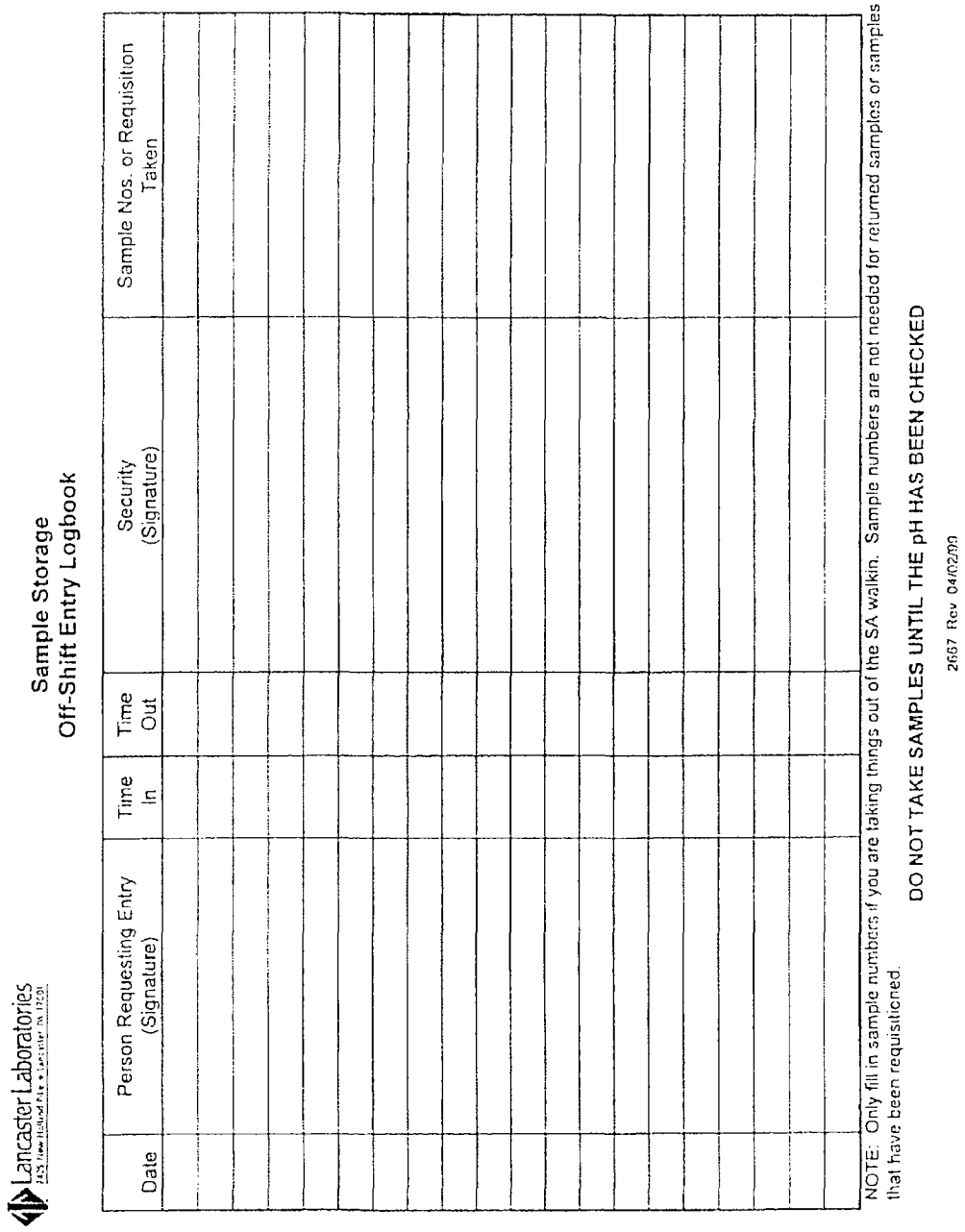
Batch No: Ø2345 5713 ØØ1

Sample Number(s) in Custody	Released By	Received By	Date of Transfer	Time of Transfer	Reason for Change of Custody
1234568, 70	J. Techprep #731	Dept 22 Storage	2/04/05	1430	digest storage
1234568, 70	Dept 22 Storage	B. K. Herr 049	2/04/05	1600	analysis
1234568, 70	B.K. Herr/049	J. Wurkbte 222	2/04/05	1700	shift change
1234568, 70	J Wurkbte 222	dept 22 Storage	2/04/05	2300	storage
1234568, 70	dept 22 Storage	K. Dean 392	2/18/05	1100	digest disposal

____ of ____

2231 01

Figure 6



Lancaster Laboratories

Sample Storage
Off-Shift Entry Logbook

Date	Person Requesting Entry (Signature)	Time In	Time Out	Security (Signature)	Sample Nos. or Requisition Taken

NOTE: Only fill in sample numbers if you are taking things out of the SA walkin. Sample numbers are not needed for returned samples or samples that have been requisitioned.

DO NOT TAKE SAMPLES UNTIL THE pH HAS BEEN CHECKED

2667 Rev 04/02/99

Semivolatile Spiking and Calibration Standards

Reference:

Compounds and concentrations required are taken from the following methods as well as client requirements.

1. Method 8270C, SW-846, USEPA, 3rd Edition, December 1996.
2. *Federal Register,* Vol.55, No.126, Friday, June 29,1990, (TCLP).
3. *Federal Register,* Vol. 57, No.227, November 24, 992, p.55114 (TCLP).
4. *Federal Register,* Vol. 51, No. 216, Friday, November 7,1986 (CCWE).
5. *Federal Register,* Vol. 57, No. 160, August 18,1992, p. 37203 (CCWE).
6. EPA Method 625, 40 CFR, Chapter 1, Jul. 1, 1999 Edition, Part 136, App. A.
7. *Contract Laboratory Program Statement of Work for Organic Analysis, OLM03.2 (3/90),* USEPA.
8. *Contract Laboratory Program Statement of Work for Organic Analysis, OLM04.3,* USEPA.
9. Method 95-2, NYSDEC, June 2000.
10. DNREC Method. December 1992.
11. J. W. Eichelberger, T.D. Behymer, W. L. Budde, Determination of Organic Compounds in Drinking Water by Liquid-Solid Extraction and Capillary Column Gas Chromatography/Mass Spectrometry, Method 525.2, Revision 2.0,Environmental Monitoring Systems Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, March 1994.

12. Method 8310, SW-846, USEPA, 3rd Edition, December 1996.

13. EPA Method 610, 40 CFR. November 7, 1987 Edition.

14. *Chemical Hygiene Plan*, Lancaster Laboratories, Inc., current version.

Cross Reference:

Document	Document Title
Form 1381	Preparation of Calibration Standards
Form 1385	Preparation of Spikes and Special Mixes
Form 1396	Preparation of Working Stock
Form 2882	Preparation of 525 Spikes and Special Mixes
Form 2883	Preparation of 525 Working Stock
Form 2884	Preparation of 525 Calibration Standards

Purpose:

Protocols for the preparation of standard solutions are critical in assuring that reproducible and accurate data is generated in the laboratory. This SOP outlines how high-quality standard solutions are to be prepared to accomplish this goal.

Scope:

This SOP will review the preparation, documentation, and storage of calibration, and check solutions as well as spiking solutions required for semivolatile compounds by GC/MS.

Personnel Training and Qualifications:

All personnel involved in the preparation of calibration and check solutions must have read this SOP detailing the preparation procedures. They must also have a working knowledge of the use of macro and micro syringes as well as safety procedures required in the use of various solvents. Personnel will be considered proficient at making solutions when they have shown that they can prepare and document the solution correctly without error and that the solution passes the calibration criteria set forth by the method. All training that occurs will be documented in that person's training manual.

Safety Precautions and Waste Handling:

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

Most of the compounds used in making the standards are toxic and carcinogenic. Extreme care should be taken when making standards. Always wear gloves, a lab coat, and safety glasses when working directly with reagents. Rinse all disposable glassware used in making standards (such as pipettes and vials) with methylene chloride before disposal. Carefully clean up all spills on countertops and floors in accordance with the Chemical Hygiene Plan. All solvent waste will be disposed of in the proper receptacles throughout departments 26 and 36. These waste receptacles will be recycled (if applicable) or disposed of in the lab-wide disposal facility.

Reagents and Standards:

1. Methylene Chloride – Pesticide Grade or equivalent

2. Acetone – Pesticide Grade or equivalent

3. Methanol – Pesticide Grade or equivalent

4. Ethyl Acetate – Fisher Optima or equivalent

5. All reagents have a 1-year shelf life and should be stored at room temperature

Procedure:

NOTE: General standard information – Before using any of the stock standards or mixes, especially the internal mix, warm to room temperature and sonicate thoroughly to dissolve any precipitate. Use syringes to measure all stock volumes. Do not measure volumes less than 20% of the syringe capacity. Rinse syringes thoroughly with methylene chloride with each change of stock solutions. All calibration standards should be made in volumetric flasks and brought to volume with methylene chloride unless otherwise noted.

NOTE: Special compounds may be added to spikes and calibration solutions as necessary. These compounds and concentrations should be determined by the analyst and added in appropriate proportions to achieve proper concentrations. If a modification to a solutions final volume is required, adjust the volume of stock solutions added to achieve the appropriate concentrations.

A. Preparation of stock standard solutions

The MS/MSD and LCS spiking solutions, the surrogate standard solutions, the miscellaneous stock standard, and calibration working stock standards should be made as follows:

1. MS/MSD and LCS spiking solutions

   a. CLP matrix spiking solution – See EPA CLP SOW OLM03.2 SV D14 and for OLM04.2, SV D14. Purchase an OLM03.2 acid matrix spike mix at 7500 µg/mL and a OLM03.2 B/N matrix spike mix at 5000 µg/mL from Restek or equivalent (see Table I).

NOTE: It is recognized that the OLM03.2 protocol requires 1,4-Dichlorobenzene and 1,2,4-Trichlorobenzene in the matrix spike solution but OLM04.2 does not.

To prepare the final CLP matrix spiking solution, make a 50 dilution of both matrix spike stock solutions in methanol. The final concentrations are 150 µg/mL and 100 µg/mL respectively. See the manufacturer expiration date for stock solutions and replace all spiking solutions every 12 months or by manufacturers expiration dates whichever is sooner. Solutions are stored cold at <4°C.

b. 8270 LCS/matrix spike spiking solution – See EPA Method 8000B, page 40, step 8.5.1 and 8.5.2. All compounds, both base/neutral and acid, should be at 100 µg/mL in the final spiking solution. There are two exceptions, benzidine and hexachlorocyclopentadiene. Due to the poor response of these compounds, a fortification mix is added to yield a concentration of 500 µg/mL for benzidine and 200 µg/mL for hexachlorocyclopentadiene. Purchase a LCS spiking set of mixes from *Supelco or equivalent (see Table II). Mixes 861198 and 861199 at* 1000 ppm, mixes 861201, 861202, and 861204 at 2000 ppm and mix 861203 at 3000 ppm. Quantitatively measure 20 mL of mix 861198 and 861199 and 10 mL of each mix, 861201, 861202, 861203, 861204 and transfer into a 200-mL amber volumetric flask containing about 100 mL of methylene chloride. Sonicate to dissolve and dilute to a final volume of 200 mL. This standard should be prepared monthly. Solutions are stored cold at <4°C.

Spike Solution

Mix	Concentration (ppm)	Amount Added (mL)
861198	1000	20
861199	1000	20
861201	2000	10
861202	2000	10
861203	3000	10
861204	2000	10

c. Appendix IX matrix spiking solution – See EPA Method 8270C. *All compounds, both base/neutral and acid, should be at 100 µg/mL in* the final spiking solution. There are five exceptions: 1,4-phenylenediamine, 1,4-naphthoquinone, 4-nitroquinoline, benzidine, and hexachlorocyclopentadiene. Due to poor response of these compounds, fortification mixes are added to yield a concentration of 1000 µg/mL for 1,4-phenylenediamine, 500 µg/mL for 1,4-naphthoquinone, 4-nitroquinoline, and benzidine, and 200 µg/mL for hexachlorocyclopentadiene. To prepare the fortification mixes for hexachlorocyclopentadiene, benzoic acid, and carbazole, quantitatively weigh 200 mg ± 10 mg of hexachlorocyclopentadiene, benzoic acid, and carbazole into a 100-mL volumetric flask containing about 50 mL of methylene chloride. Sonicate to dissolve and dilute to a final volume of 100. Benzoic acid and carbazole are not in the purchased mixes, therefore are added to this intermediate stock. To prepare the fortification mix for 1,4-phenylenediamine, quantitatively weigh 185 mg ± 10 mg of 1,4-phenylenediamine and transfer into a 10-mL amber volumetric flask containing about 5 mL of methylene chloride. Sonicate to dissolve and dilute to a final volume of 10 mL. To prepare the fortification mix for benzidine quantitatively weigh 1 g ± 10 mg of benzidine and transfer into a 200-mL amber volumetric flask containing about 50 mL of methylene chloride. Sonicate to dissolve and dilute to a final volume of 200 mL. To prepare fortification mixes for 1,4-naphthoquinone, 4-nitroquinoline, and azobenzene, quantitatively

weigh 250 ± 10 mg of 1,4-naphthoquinone, 245 ± 10 mg of 4-nitroquinoline, and 63 ± 1 mg of azobenzene. Transfer each to a 10-mL amber volumetric flask containing about 5 mL of methylene chloride. Sonicate to dissolve and dilute to a final volume of 10 mL. Several stock solutions are purchased from Ultra Scientific to prepare the final Appendix IX spiking solution: US-104, 20030492, US-107, US-110, US-111, US-113, US-114, US-115, US-116, US-117, US-118, US-119, US-120A (see Table IV). To prepare the final Appendix IX spiking solution, measure 1250 µL of stocks US-104, 20030492, US-107, US-110, US-111, US-113, US-114, US-115, US-116, US-117, US-118, US-119, US-120A, 1,4-phenylenediamine, hexachlorocyclopentadiene, benzoic acid, and carbazole into a 25-mL amber volumetric flask. Also add 400 µL of 1,4-naphthoquinone, azobenzene, 4-nitroquinoline, and 2000 µL of benzidine fortification mix. Dilute to a final volume of 25 mL with methylene chloride. All stocks should be stored in the freezer and prepared every 12 months. This standard should be prepared every 7 days or as needed whichever is sooner. Solutions are stored cold at <4°C.

Intermediate Stocks

Compound	Weight	Volume	Concentration
Hexachlorocyclopentadiene carbazole benzoic acid	200 mg ± 10mg	100 mL	2000 µg/mL
Benzidine	1 g ± 10 mg	200 mL	5000 µg/mL
1,4-phenylenediamine	185 mg ± 10	10 mL	18000 µg/mL
Azobenzene	63 mg ± 1	10 mL	6000 µg/mL
1,4-naphthoquinone	250 mg ± 10	10 mL	25000 µg/mL
4-nitroquinoline-1-oxide	245 mg ± 10	10 mL	25000 µg/mL

Spike Solution

Mix	Concentration (ppm)	Amount Added (µL)
US-104N-4	2000	1250
20030492	2000	1250
US-107N-4	2000	1250
US-110-4	2000	1250
US-111-4	2000	1250
US-113N-4	2000	1250
US-114-4	2000	1250
US-115-4	2000	1250
US-116-4	2000	1250
US-117N-4	2000	1250
US-118-4	2000	1250
US-119-4	2000	1250
US-120A-4	2000	1250
hexachlorocyclopentadiene carbazole benzoic acid	2000	1250
1,4-naphthoquinone	25000	1250
1,4-phenylenediamine	18000	1250
azobenzene	6000	400
Benzidine	5000	2500
4-nitroquinoline-1-oxide	25000	400

d. 625 LCS/Matrix Spike spiking solution – (same as 8270 matrix spiking solution – See 8270 LCS/Matrix Spiking solution section A.1.b.)

e. 525 matrix spiking solution

All compounds should be at the concentrations listed in the table below for the corresponding mix. There are three exceptions:

(1) Benzo(a)pyrene is at 0.4 µg/mL

(2) Pentachlorophenol is at 8 µg/mL

(3) Endrin is at 4 µg/mL

Seven mixes are purchased to prepare the final spiking solution (see Table VI). Mixes RPCM-525A, PPM-525D, PSM-525A, CUS-2193 and CUS-1690 are purchased from Ultra Scientific. Mixes 553519 and 32219 are purchased from Restek. All stock solutions should be replaced based on manufacturer's expiration dates. To prepare the final LFB matrix spiking solution measure the volume for each mix indicated in the table below into a 25 mL volumetric flask containing about 15 mL of acetone. Dilute to a final volume of 25 mL with acetone. Solutions are stored in amber vials, cold at <-10°C.

LFB Matrix Spike Solution

Mix	Concentration (ppm)	Amount Added (µL)	Final Conc. (µg/mL)
RPCM-525A	500	200	4
PPM-525D	500	20	0.4*
PSM-525A	500	100	2
553519	500	200	4
CUS-2193	100	1000	4
CUS-1690	500	200	4
32219	1000	90	3.6*

*Final concentration for Endrin = 4 µg/mL

2. Surrogate standard solutions

a. CLP surrogate standard solution – See EPA CLP SOW OLM03.2, page SV D14 and OLM04.2, page SV D14. Purchase a 3/90 acid surrogate mix (see Table III) at a concentration of 7500 µg/mL and a 3/90 B/N surrogate mix at a concentration of 5000 µg/mL from Restek or equivalent. Final concentrations should be at 150 µg/mL for acids

and 100 µg/mL for bases. To prepare the final 3/90 surrogate spike solution, make a 50 dilution of both surrogate stock solutions in methanol. The stock solutions should be replaced every 12 months. Solutions are stored cold at <4°C.

b. BNA surrogate standard solution – Acid compounds (2-fluorophenol, 2,4,6-tribromophenol and phenol-d5) should be at 4000 µg/mL and B/N compounds (2-fluorobiphenyl, *p*-terphenyl-d14 and nitrobenzene-d5) at 4000 µg/mL in the final spiking solution, before adding it to the working stock. This spiking solution is used for 8270, 625, and Appendix IX analyses (see Table III). This spike is purchased from Supelco and is added to the working stock to obtain a final concentration of 200 µg/mL. Solutions are stored cold at <4°C and should be prepared or retested every 6 months.

c. 525 internal surrogate standard spiking solution – See EPA Manual 525.2. *Purchase an Internal Standards Mix from Supelco or equivalent* (see Table VII) at 2000 µg/mL. To prepare the final internal standard spiking solution, make a 40 dilution of the stock solution in acetone. The stock solution should be replaced every 12 months and the standard every month. Solutions are stored cold at <4°C.

3. Miscellaneous stock standard solutions

a. Gel permeation cleanup calibration solution – See EPA CLP SOW OLM03.2, page SV D15 and OLM04.2, page SV D15. Purchase a CLP GPC calibration mix from Restek or equivalent with concentrations of corn oil at 250 mg/mL, *bis*(2-ethylhexyl)phthalate at 10 mg/mL, methoxychlor at 2.0 mg/mL, perylene at 0.2 mg/mL, and sulfur at 0.8 mg/mL. Prepare a 20-fold dilution of the stock solution for use on the GPC. The stock solution should be replaced every 6 months. Solutions are stored cold at <4°C.

b. CLP method Decafluorotriphenylphosphine (DFTPP) tuning solution. Measure 250 µL of Absolute Standards tuning standard containing 500 µg/mL each of Decafluorotriphenylphosphine equivalent into a 5-mL volumetric flask containing approximately 2 mL of methylene chloride. Dilute to volume with methylene chloride and mix. Transfer approximately 1 mL to amber GC vials, label, and store in refrigerator until use. Record the preparation in the Spikes and Special Mixes Laboratory Data Notebook (Figure 1). This solution must be prepared every 6 months. A 25-µg/mL DFTPP standard is made every 6 months. When the 2-µL injection is made on the instrument the concentration is 50 µg/mL. Solutions are stored cold at <4°C.

c. 8270, 625, and Appendix IX Decafluorotriphenylphosphine (DFTPP) tuning solution – Prepare a working standard in which DFTPP, pentachlorophenol, benzidine, and p,p'-DDT are at 50 µg/mL. Measure 1000 µL of Absolute Standards tuning standard containing 500 µg/mL each of Decafluorotriphenylphosphine, pentachlorophenol, benzidine, and p,p'-DDT or equivalent into a 10-mL volumetric flask containing approximately 5 mL of methylene chloride. Dilute to volume with methylene chloride and mix. Transfer approximately 1 mL to amber GC vials, label, and store in refrigerator until use. Record the preparation in the Spikes and Special Mixes Laboratory Data Notebook (Figure 1). This solution must be prepared every 6 months. Solutions are stored cold at <4°C.

d. 525 Method Decafluorotriphenylphosphine (DFTPP)/ Endrin tuning solution – Prepare a working standard in which DFTPP, pentachlorophenol, benzidine, and p,p'-DDT are at 5 µg/mL and Endrin is at 5 µg/mL. Measure 500 µL of Absolute Standards tuning standard containing 500 µg/mL each of Decafluorotriphenylphosphine, pentachlorophenol, benzidine, and p,p'-DDT or equivalent and 250 µL of 1000 µg/mL Endrin solution into a 50-mL volumetric flask containing approximately 25 mL of methylene chloride. Dilute to volume with methylene chloride and mix. Transfer approximately 1 mL to amber

GC vials, label, and store in refrigerator until use. Record the preparation in the 525 Spikes and Special Mixes Laboratory Data Notebook (Figure 2). This solution must be prepared every 6 months. Solutions are stored cold at <4°C.

4. Calibration standard working stock solutions

   a. Methods OLM04.2/OLM03.2 CLP standards working stock –CLP standards working stock is prepared with all compounds, both base neutral and acid, at 200 µg/mL. To prepare the working stock, measure the following stock mixes in a 5-mL volumetric flask:

Mix	Concentration (ppm)	Amount Added (µL)
CLP SVOA Calib. Mix	1000	1000
N-Nitrosodiphenylamine	5000	200
BN Surrogates	5000	200
AC Surrogates	7500	133
3,3' Dichlorobenzene	5000	200
Pyridine	2000	500

Dilute with methylene chloride to a final volume of 5 mL. This working stock should be prepared every 12 months or sooner if comparison with QC check samples indicates a problem. This solution should be stored cold at <-10°C The preparation of this CLP working stock is recorded in the Working Stocks notebook (Figure 3). Special compounds may be added to CLP working stock. These concentrations are to be determined by the analyst and added in appropriate proportions to achieve the desired concentrations. The preparation of specials for CLP working stock is also recorded in the Working Stocks notebook (Figure 3). (See Table VIII for CLP SVOA Calibration Mix compounds.)

b. Methods 8270C/625/TC8/TCLP/CCW/ /APPIX – BNA standards working stock – A BNA standards working stock is prepared with all compounds, both base neutral and acid, at 200 µg/mL, except benzidine at 400 µg/mL. To prepare the working stock, measure the following stock mixes in a 25-mL volumetric flask.

Mix	Concentration (ppm)	Amount Added (µL)
8270 Mix 1	1000	5000
8270 Mix 2A	2000	2500
8270 Surrogate Standard Mix	4000	1250
8270 Cal Mix 3	2000	2500
Quote 20505523	2000	2500
Benzidine Mix	2000	2500
OLM04 Mix	5000	2500
N-Nitrosodiphenylamine	5000	1000
Benzidine fortification	20000	500

Dilute with methylene chloride to a final volume of 25 mL. This BNA working stock should be prepared every 6 months or sooner if comparison with QC check samples indicates a problem. This solution should be stored cold at <-10°C. The preparation of this BNA working stock is recorded in the Working Stocks notebook (Figure 3). Special compounds may be added to BNA working stock. These concentrations are to be determined by the analyst and added in appropriate proportions to achieve the desired concentrations. The preparation of specials for BNA working stock is also recorded in the Working Stocks notebook (Figure 3).

e. Method 525 standards working stock – A 525 standards working stock is prepared with all compounds, both base/ neutral and acid, at 20 µg/mL, except benzidine and pentachlorophenol at 60 µg/mL and gas specials at 10 µg/mL. To prepare the working stock, measure the following stock mixes in a 5-mL volumetric flask:

Mix	Concentration (ppm)	Amount Added (µL)
BNA Working Stock	200	500
PCP Fortification	3000	100
M-525-2-5X	500	200
M-525-3-5X	500	200
Custom Mix	500	200
Gas Specials	500	100
bis(2-ethylhexyl)adipate	1000	100

Dilute with Ethyl acetate to a final volume of 5 mL. This 525 working stock should be prepared every 2 months or sooner if comparison with QC check samples indicates a problem. This solution should be stored cold at <-10°C. The preparation of this 525 working stock is recorded in the 525 Working Stocks Notebook (Figure 4).

B. Preparation of calibration standards

1. Methods 8270C/625/TC8/TCLP/CCW/APPIX calibration standards – Six calibration standards are prepared weekly as needed or more frequently if needed, at the following levels: 5 µg/mL, 15 µg/mL, 30 µg/mL, 50 µg/mL, 80 µg/mL, and 120 µg/mL. Solutions are stored cold at <4°C. The standards are prepared by diluting the BNA standards working stock. MDL fortification is added to the 625, 5-µg/mL standard. Note that the 5 µg/mL, 15 µg/mL, 30 µg/mL, and the 5 µg/mL (625) have fortifications added to them for some compounds (see chart for

compounds and concentrations). Also, the 1 µg/mL (MDL/LOQ) has been fortified and is shown in the chart. Internal standard is added to each of the calibration standards. The standards are named by using the prefix STD followed by three digits, which represent the Julian day of the year on which they were prepared and a fourth, and final digit representing the year. The preparation of these standards should be recorded in the formatted and ring-bound Calibration Standards Notebook (Figure 5). An example page from this notebook can be used as a guide in preparing the calibration standards.

Mix	Conc (ppm)	MDL 1 ppm	625 5 ppm	5 ppm	15 ppm	30 ppm	50 ppm	80 ppm	120 ppm
BNA Working Stock	*	25	25	50	150	300	1250	800	1200
Internal STD	2000	100	20	40	40	40	100	40	40
2-Fluoronaphthalene **	2000		20			40	100	40	40
Benzoic Acid	1000	50	15	30	60	80	250	160	240
Pentachlorophenol	1000			20	30	20			
2,4-Dinitrophenol	1000		10	20	30	20			
Benzidine	1000	25							
4-Nitrophenol	1000		5	10					
4,6-Dinitro-2-methylphenol	1000		5	10					
Benzyl alcohol	1000	5	5	10	30	60	250	160	240
625 Add-in Mix ***	2000		2.5			30	125	80	120
Special MDL Mix	*	50							
Final Volume (mL)		5.0	1.0	2.0	2.0	2.0	5.0	2.0	2.0

- * Compounds fortified at various concentrations.
- ** Internal Standard is used for 625 Standards only instead of Napthalene-d8.
- *** Mix is used in 625 Standards only.

For method 8270C and 625 an internal calibration verification (ICV) standard is also prepared. It is run during an initial calibration. The standard is prepared biweekly as needed or more frequently if needed. The ICV is prepared at 50 ug/mL and is stored cold at <4 degrees C. The ICV is prepared by diluting ampulated mixes to a final concentration of 50 ug/mL in methylene chloride. Internal standard is also added to the mixes, see chart for mixes and concentrations. The standard is named by using the prefix ICV followed by three digits, which represent the Julian day of the year on which they were prepared and a fourth, and final digit, representing the year. The preparation of this standard should be recorded in the formatted and ring-bound Calibration Standards Notebook (Figure 5). An example page from this notebook can be used as a guide in preparing the standard.

Mix	Conc (ppm)	50 ppm
Internal Standard	2000	200
Surrogate Mix 8270	4000	125
Mix A	1000	500
Mix B	2000	250
Mix C	2000	250
Mix D	2000	250
Mix E	2000	250
Mix F	1000	500
Mix G	1000	500
Mix I	2000	250
Mix J	2000	250
Mix L	1000	500
Mix N	2000	250
Mix O	*8000	625
625 Add-in Mix	10000	50*
Final Volume (mL)		10.0

NOTE: these mixes are ampulated stocks directly from the vendor. The compounds in these mixes and their corresponding concentrations are found in the Department Certificate of Analysis ringbinder.
*Used in 625 ICV only

2. OLM04.2 and OLM03.2 method CLP calibration standards – Five calibration standards are prepared every 2 weeks, as needed, or more frequently if needed, at the following levels: 5 µg/mL, 25 µg/mL, 40 µg/mL, 60 µg/mL, and 80 µg/mL. Solutions are stored cold at <4°C. The standards are prepared by diluting the CLP standards working stock. Internal standard is added to each of the five calibration standards, but not to DFTPP. The standards are named by using the prefix CLP followed by the three digits, which represent the Julian day of the year in which they were prepared and a fourth, and final digit representing the year. The preparation of these standards should be recorded in the formatted and ring-bound Calibration Standards Notebook (Figure 5). An example page from this notebook can be used as a guide in preparing the calibration standards.

Mix	Conc. (ppm)	5 ppm	25 ppm	40 ppm	60 ppm	80 ppm
CLP Working Stock	200	25	125	200	300	400
Internal STD	2000	10	10	10	10	10
OLM04 Custom Mix	2000	2.5	12.5	20	30	40
Phenols Mix	1000/ 2000	2.5	12.5	20	30	40
SV Mix 1	2000	2.5	12.5	20	30	40
SV Mix 2	2000	2.5	12.5	20	30	40
Hercules Special Mix *	2000	2.5	12.5	20	30	40

(See Table VIII for OLM04 Custom Mix)

* Hercules Special Mix is only added when needed for certain clients.

3. Method 525 calibration standards – Six calibration standards are prepared weekly, or more frequently if needed, at the following levels: 0.1 µg/mL, 0.5 µg/mL, 1.0 µg/mL, 2.0 µg/mL, 5.0 µg/mL, and 10.0 µg/mL. Solutions are stored cold at <4°C. The standards are prepared by diluting the 525 standards working stock. The standards are named by using the prefix 525 followed by the three digits which represent the Julian day of the year in which they were prepared and a fourth and final digit representing the year. The preparation of these standards is recorded in the 525 Standards Notebook (Figure 6).

Mix	Conc. (ppm)	0.1 ppm	0.5 ppm	1.0 ppm	2.0 ppm	5.0 ppm	10.0 ppm	(MDL) THNA 0.01 ppm	(MDL) 525.2 0.02 ppm
EPA 525.2 STK	50		20	40	80	200	400		
THNA Working STK	50		20	40	80	200	400		
525 IS/SS**	50	200	200	200	200	200	200	200	200
THNA Int. Working STK	1	200						20	
EPA 525.2 Int. Working STK	1	100							40
Final Volume (mL)		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

** See Table VII for compounds

4. Special compounds – Special, nonroutine compounds may be requested. These spikes and mixes are prepared at the discretion of the analyst. The preparation is recorded in the spikes and special mixes notebook (Figure 1).

Revision Log:

Ver. #	Effective Date	Change
00	08/20/96	Previous issue
01	04/21/00	Major changes are as follows: • All sections replaced • Added surrogate and LCS/MS/MSD spike preparation • Updated mixes used for calibration standards • Added 525 spikes
02	05/17/01	Major changes are as follows: • Storage conditions added • Typographical errors on pp7 and 10 fixed • Procedural Amendment #1 added
03	07/18/01	Major changes are as follows: • Preparation of all APPIX stocks, spikes, and standards deleted • Updated preparation of working stock for 8270 • Updated preparation of calibration standards for 8270 • Updated mixes for 8270 surrogates
04	10/21/02	Major changes are as follows: • A.1.e. 525 matrix spiking solution – corrected Table reference and storage of std solutions • A.2.c. 525 internal surrogate standard spiking solution – updated preparation and corrected name of supplier • B.4 Method 525 calibration standards – updated preparation of calibration standards and added preparation of MDL standards.

Ver. #	Effective Date	Change
05	APR 1 2 2005	Major changes are as follows: • Updated document to Level 3 format • Incorporated Procedural Amendment 1 • Added References • Made clarifications to Training and Safety sections • Updated Procedure for CLP, 525, and 8270 stocks and standards

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Prepared by: _____ Date: 2/23/05
Chemist

Approved by: _____ Date: 2/24/05
GC/MS Semivolatiles Management

Approved by: _____ Date: ③ WO#1467 2/25/05 ~~2/25~~ 2/25/05
Quality Assurance

Table I
CLP 3/90 Matrix Spike Solution

3/90 Acid Matrix Spike Mix	3/90 Base Neutral Matrix Spike Mix
2-chlorophenol	1,2,4-trichlorobenzene
4-chloro-3-methylphenol	1,4-dichlorobenzene
4-nitrophenol	2,4-dinitrotoluene
Pentachlorophenol	Acenaphthene
Phenol	N-nitroso-di-n-propylamine
	Pyrene

Table II
LCS Spike Solution

86-1198
1,2,4-trichlorobenzene
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
2,2'-oxybis(1-chloropropane)
2,4,6-trichlorophenol
2,4,5-trichlorophenol
2,4-dichlorophenol
2,4-dimethylphenol
2,4-dinitrophenol
2,4-dinitrotoluene
2,6-dinitrotoluene
2-chloronaphthalene
2-chlorophenol
2-methylphenol
2-nitroaniline
2-nitrophenol
2-methylnaphthalene
3-nitroaniline
3 and 4-methylphenol
4,6-dinitro-2-methylphenol
4-bromophenyl phenyl ether
4-chloro-3-methylphenol
4-chloroaniline
4-chlorophenyl phenyl ether
4-nitroaniline
4-nitrophenol
acenaphthene
acenaphthylene
anthracene
azobenzene
bis(2-chloroethoxy)methane

861199
aniline
benzoic acid
benzyl alcohol
pyridine

861201
benzidine
3,3-dichlorobenzidine
3,3'-dimethylbenzidine
bis(2-chloroethyl)ether
butylbenzylphthalate
benzo(a)anthracene
benzo(a)pyrene
benzo(b)fluoranthene
benzo(ghi)perylene
benzo(k)fluoranthene
carbazole
chrysene
di-n-butylphthalate
di-n-octylphthalate
diethylphthalate
dimethylphthalate
dibenz(a,h)anthracene
dibenzofuran
fluoranthene
fluorene
hexachlorobutadiene
hexachloroethane
hexachlorobenzene
hexachlorocyclopentadiene
isophorone
indeno(1,2,3-cd)pyrene
n-nitrosodimethylamine
n-nitrosodi-n-propylamine
naphthalene
nitrobenzene
pentachlorophenol
phenol
phenanthrene
pyrene
bis(2-ethylhexyl)phthalate

861202
n-nitrosodiphenylamine

861203
benzidine

861204
hexachlorocyclopentadiene

Table III
BNA Standard Mixes BNA Standard Mixes

8270 CALIB MIX 1
1,2,4-Trichlorobenzene SS
1,2-Dichlorobenzene SS
1,3-Dichlorobenzene SS
1,4-Dichlorobenzene SS
2,2'-oxybis(1-chloropropane) SS
2,4,5-Trichlorophenol SS
2,4,6-Trichlorophenol SS
2,4-Dichlorophenol SS
2,4-Dimethylphenol SS
2,4-Dinitrophenol SS
2,4-Dinitrotoluene SS
2,6-Dinitrotoluene SS
2-Chloronaphthalene SS
2-Chlorophenol SS
2-Methylnaphthalene SS
2-Methylphenol SS
2-Nitroaniline SS
2-Nitrophenol SS
3-Nitroaniline SS
4,6-Dinitro-2-methylphenol SS
4-Bromophenylphenylether SS
4-Chloro-3-methylphenol SS
4-Chloroaniline SS
4-Chlorophenylphenylether SS
4-Methylphenol SS
4-Nitroaniline SS
4-Nitrophenol SS
Acenaphthene SS
Acenaphthylene SS
Anthracene SS
Azobenzene SS
Benzo(a)anthracene SS
Benzo(a)pyrene SS
Benzo(b)fluoranthene SS
Benzo(g,h,i)perylene SS
Benzo(k)fluoranthene SS
Bis(2-chloroethoxy)methane SS
Bis(2-chloroethyl)ether SS
Bis(2-ethylhexyl)phthalate SS
Butyl benzyl phthalate SS
Carbazole SS
Chrysene SS
Di-n-butylphthalate SS
Di-n-octylphthalate SS
Dibenzo(a,h)anthracene SS
Dibenzofuran SS
Diethylphthalate SS
Dimethylphthalate SS
Fluoranthene SS
Fluorene SS
Hexachlorobenzene SS
Hexachlorobutadiene SS
Hexachlorocyclopentadiene SS
Hexachloroethane SS
Indeno(1,2,3-cd)pyrene SS
Isophorone SS
N-Nitroso-di-n-propylamine SS
N-nitrosodimethylamine SS
Naphthalene SS
Nitrobenzene SS
Pentachlorophenol SS
Phenanthrene SS
Phenol SS
Pyrene SS

EQUITY SS 8270 BENZIDINES MIX
3,3'-Dichlorobenzidine
3,3'-Dimethylbenzidine
Benzidine SS

CALIB MIX 2A
1,2,4,5-Tetrachlorobenzene SS
1,3,5-Trinitrobenzene SS
1,3-Dinitrobenzene SS
2,3,4,6-Tetrachlorophenol SS
2,6-Dichlorophenol SS
2-Acetylaminofluorene SS
3-Methylcholanthrene SS
4-Aminobiphenyl SS
4-Nitroquinoline-1-oxide SS
5-Nitro-o-toluidine SS
Dinoseb SS
Ethyl methanesulfonate SS
Hexachloropropene SS
Isosafrole SS
Methapyrilene SS
Methyl methanesulfonate SS
N-Nitroso-di-n-butylamine SS
N-Nitrosodiethylamine SS
N-Nitrosomethylethylamine SS
N-Nitrosomorpholine SS
N-Nitrosopiperidine SS
N-Nitrosopyrrolidine SS

Table III – Continued
BNA Standard Mixes

p-(Dimethylamino)azobenzene SS
Pentachlorobenzene SS
Pentachloroethane SS
Pentachloronitrobenzene SS
Phenacetin SS
Safrole SS
1,4-Dinitrobenzene SS
4,4'-Methylenebis(2-Chloroaniline) SS
Diallate SS

8270 Calib Mix 3
1,4-Dioxane SS
1-Naphthylamine SS
2-Naphthylamine SS
2-Picoline SS
Aniline SS
1-Methylnaphthalene
7,12-Dimethylbenz(a)anthracene SS
1-Nitronaphthalene
o-Toluidine SS
Phenyl Ether SS
Pyridine SS

625 ADD-ON MIX
1-Methylphenanthrene SS
2,3-Dichloroaniline SS
a-Terpineol SS
n-Decane SS
n-Docosane SS
n-Dodecane SS
n-Eicosane SS
n-Hexadecane SS
n-Octadecane SS
n-Tetradecane SS

N-NITROSODIPHENYLAMINE
N-Nitrosodiphenylamine SS

BENZOIC ACID
Benzoic Acid SS

BENZYL-ALCOHOL SS
Benzyl alcohol SS

OLM04 MIX
Acetophenone SS
Atrazine SS
Benzaldehyde SS
Biphenyl SS
Caprolactam SS

20185918 MIX
Chlorobenzilate
Dibenz (a,h) acridine 99%
Dibenz (a,j, acridine
Dimethoate

Dimethyl Formamide
Hexabromobenzene
Isodrin
Methyl Parathion
O,O,O-Triethylphosphorothioate
Parathion
Phorate
Pronamide
Quinoline
Ronnel
Sulfotep
Thionazin
1-Chloronaphthalene
1,4-Naphthoquinone
6-Methylchrysene

ACID SURROGATE (3/90) MIX
2-fluorophenol
2-chlorophenol-d4
phenol-d6
2,4,6-tribromophenol

BNA SURROGATE (3/90) MIX
2-fluorobiphenyl
nitrobenzene-d5
1,2-dichlorobenzene-d4
p-terphenyl-d14

INTERNAL STANDARDS MIX
1,4-dichlorobenzene-d4
naphthalene-d8
acenaphthene-d10

Table IV
Appendix IX Mixes

US-104N-4
aniline
benzyl alcohol
4-chloroaniline
dibenzofuran
2-methylnaphthalene
2-nitroaniline
3-nitroaniline
4-nitroaniline

20030492
acenaphthene
acenaphthylene
anthracene
benzo(a)anthracene
benzo(b)fluoranthene
benzo(k)fluoranthene
benzo(ghi)perylene
benzo(a)pyrene
chrysene
dibenz(a,h)anthracene
fluoranthene
fluorene
indeno(1,2,3-cd)pyrene
naphthalene
phenanthrene
pyrene

US-107N-4
4-chloro-3-methylphenol
2-chlorophenol
2,4-dichlorophenol
2,4-dimethylphenol
2,4-dinitrophenol
4,6-dinitro-2-methylphenol
2-nitrophenol
4-nitrophenol
pentachlorophenol
phenol
2,4,6-trichlorophenol

US-110-4
bis-chloroethoxy)methane
bis(2-chloroethyl)ether *bis*(2-ethylhexyl)phthalate
bis(2-chloroisopropyl)ether
4-bromophenyl phenyl ether
butylbenzyl phthalate
4-chlorophenyl phenyl ether
diethyl phthalate
dimethyl phthalate
di-n-butyl phthalate
di-n-octyl phthalate

US-111-4
2-chloronaphthalene
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
hexachlorobenzene
hexachlorobutadiene
hexachlorocyclopentadiene
hexachloroethane
hexachloropropene
pentachlorobenzene
pentachloroethane
1,2,4,5-tetrachlorobenzene
1,2,4-trichlorobenzene

US-113N-4
N-nitrosodi-n-butylamine
N-nitrosodiethylamine
N-nitrosodimethylamine
N-nitrosodiphenylamine
N-nitrosodi-n-propylamine
N-nitrosomethylethylamine
N-nitrosomorpholine
N-nitrosopiperidine
N-nitrosopyrrolidine

Table IV – Continued
Appendix IX Mixes

US-114-4
2-acetylaminofluorene
4-aminobiphenyl
3,3'-dichlorobenzidine
p-(dimethylamino)azobenzene
3,3'-dimethylbenzidine
a,a-dimethylphenethylamine
diphenylamine
1-naphthylamine
2-naphthylamine
5-nitro-o-toluidine
phenacetin
1,4-phenylenediamine
o-toluidine

US-115-4
acetophenone
1,3-dinitrobenzene
2,4-dinitrotoluene
2,6-dinitrotoluene
ethyl methanesulfonate
isophorone
isosafrole
methyl methanesulfonate
1,4-napthoquinone
nitrobenzene
pentachloronitrobenzene
safrole
1,3,5-trinitrobenzene

US-116-4
3-methylphenol
3 and 4 methylphenol
2,6-dichlorophenol
dinoseb (DNBP)
hexachlorophene
2,3,4,6-tetrachlorophenol
2,4,5-trichlorophenol
3-methylcholanthrene
7,12-dimethylbenz(a)anthracene

US-117N-4
2-methylphenol

US-118-4
aramite
chlorobenzilate
diallate
isodrin
kepone
pronamide

US-119-4
dimethoate
disulfoton
famphur
O,O-diethyl O-2-pyrazinyl-
phosphorothioate (thionazin)
O,O,O-triethyl phosphorothioate
methyl parathion
ethyl parathion
phorate
tetraethyl dithiopyrophosphate
(sulfotepp)

US-120AN-4
methapyrilene
4-nitroquinoline-1-oxide
2-picoline
pyridine

Table V
Method 525 Specialty Mixes

M-525-2-5X
2-chlorobiphenyl (BZ-001)
2,3-dichlorobiphenyl (BZ-005)
2,2',3,3',4,4',6-heptahclorobiphenyl (BZ-171)
2,2',4,4',5,6'-hexachlorobiphenyl (BZ-154)
2,2',3,3',4,5',6,6'-octachlorobiphenyl (BZ-201)
2,2',3',4,6-pentachlorobiphenyl (BZ-098)
2,2',4,4'-tetrachlorobiphenyl (BZ-047)
2,4,5-trichlorobiphenyl (BZ-029)

M-525-3-5X
alachlor
aldrin
atrazine
α-chlordane
γ-chlordane
endrin
heptachlor
heptachlor epoxide
lindane
methoxychlor
simazine
trans-nonachlor

M-525-4-5X
buthylbenzylphthalate
di-n-butylphthalate
diethylphthalate
bis(2-ethylhexyl)adipate
dimethylphthalate
hexachlorobenzene
hexachlorocyclopentadiene
bis(2-ethylhexyl)phthalate
pentachlorophenol

S-1017A-5X CUSTOM PESTICIDE MIX
butachlor
metolachlor
metribuzin
propachlor

Z-014G-R PAH MIX
napthalene
acenaphthylene
acenaphthene
fluorene
phenanthrene
anthracene
carbazole
fluoranthene
pyrene
chrysene
benzo(a)anthracene
benzo(b)fluoranthene
benzo(k)fluoranthene
benzo(a)pyrene
indeno(1,2,3-cd)pyrene
dibenz(a,h)anthracene
benzo(g,h,i)perylene

S-2894 CUSTOM PESTICIDE MIX
dibenzofuran
dieldrin
di-n-octylphthalate
1-methylnaphthalene
2-methylnaphthalene
cis-nonachlor

Table VI
Method 525 Spike Mixes

RPCM-525A
2-chlorobiphenyl (BZ-001)
2,3-dichlorobiphenyl (BZ-005)
2,2',3,3',4,4',6-heptahclorobiphenyl (BZ-171)
2,2',4,4',5,6'-hexachlorobiphenyl (BZ-154)
2,2',3,3',4,5',6,6'-octachlorobiphenyl (BZ-201)
2,2',3',4,6-pentachlorobiphenyl (BZ-098)
2,2',4,4'-tetrachlorobiphenyl (BZ-047)
2,4,5-trichlorobiphenyl (BZ-029)

PPM-525D
alachlor
aldrin
atrazine
α-chlordane
γ-chlordane
endrin
heptachlor
heptachlor epoxide
lindane
methoxychlor
simazine
trans-nonachlor

PSM-525A
buthylbenzylphthalate
di-n-butylphthalate
diethylphthalate
bis(2-ethylhexyl)adipate
dimethylphthalate
hexachlorobenzene
hexachlorocyclopentadiene
bis(2-ethylhexyl)phthalate pentachlorophenol

CUS-1689
butachlor
metolachlor
metribuzin
propachlor

553519
napthalene
acenaphthylene
acenaphthene
fluorene
phenanthrene
anthracene
carbazole
fluoranthene
pyrene
chrysene
benzo(a)anthracene
benzo(b)fluoranthene
benzo(k)fluoranthene
benzo(a)pyrene
indeno(1,2,3-cd)pyrene
dibenz(a,h)anthracene
benzo(g,h,i)perylene

CUS-1690
dibenzofuran
dieldrin
di-n-octylphthalate
1-methylnaphthalene
2-methylnaphthalene
cis-nonachlor

32219
endrin

Table VII
525 Internal/Surrogate Mix

IS-525M
acenaphthene-d10
chrysene-d12
phenanthrene-d10

SS525-1M
2-NMX
perylene-d12
triphenyl phosphate

Table VIII
OLM04.2 Standard Mix

CLP SVOA Calibration Mix
1,2,4-trichlorobenzene
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
2,4,6-trichlorophenol
2,4,5-trichlorophenol
2,4-dichlorophenol
2,4-dimethylphenol
2,4-dinitrophenol
2,4-dinitrotoluene
2,6-dinitrotoluene
2-chloronaphthalene
2-chlorophenol
2-methylphenol
2-nitroaniline
2-nitrophenol
2-methylnaphthalene
3-nitroaniline
3 and 4-methylphenol
4,6-dinitro-2-methylphenol
4-bromophenyl phenyl ether
4-chloro-3-methylphenol
4-chloroaniline
4-chlorophenyl phenyl ether
4-nitroaniline
4-nitrophenol
acenaphthene
acenaphthylene
anthracene
azobenzene
bis(2-chloroethoxy)methane
bis(2-chloroethyl)ether
bis (2-chloroisopropyl) ether
bis(2-ethylhexyl)phthalate
butylbenzylphthalate
benzo(a)anthracene
benzo(a)pyrene
benzo(b)fluoranthene
benzo(ghi)perylene
benzo(k)fluoranthene
carbazole
chrysene
di-n-butylphthalate
di-n-octylphthalate
diethylphthalate
dimethylphthalate
dibenz(a,h)anthracene
dibenzofuran
fluoranthene
fluorene
hexachlorobutadiene
hexachloroethane
hexachlorobenzene
hexachlorocyclopentadiene
isophorone
indeno(1,2,3-cd)pyrene
n-nitrosodimethylamine
n-nitrosodi-n-propylamine
naphthalene
nitrobenzene
pentachlorophenol
phenol
phenanthrene
pyrene

OLM04 Custom MIX
Acetophenone
Atrazine
Benzaldehyde
Biphenyl
Caprolactam

SV Mix 1
N,N Dimethylformamide
1,2,3 Trimethylbenzene
1,2,4,Trimethylbenzene
1,3,5 Trimethylbenzene

4-Chloro-3-nitrobenzotrifluride
Phthalic anhydride
4-(tert-Octyl)phenol

SV Mix 2
2-Methylcyclohexanone
3-Methylcyclohexanone
4-Methylcyclohexanone
Aniline
o-Toluidine
2,6 Dinitrophenol

Phenols Mix
2-tert-Butylphenol
3-tert-Butylphenol
4-tert-Butylphenol
2,4 Di-tert-butylphenol
2,6,Di-tert-butylphenol
3,5 Di-tert-butylphenol

Figure 1

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

Preparation of Spikes and Special Mixes

Compound/Mix	Lot #	Exp. Date	Vendor	Density g/ml	%Purity	Initial Conc ppm	Actual Amount	Final Conc. ppm	Solvent	Location

Brought to a final volume _____ in $MeCl_2$ Lot # _____

Comments: _____

_____

Prepared by: _____ Date: _____

Compound/Mix	Lot #	Exp. Date	Vendor	Density g/ml	%Purity	Initial Conc ppm	Actual Amount	Final Conc ppm	Solvent	Location

Brought to a final volume _____ in $MeCl_2$ Lot # _____

Comments: _____

_____

Prepared by: _____ Date: _____

1385 Rev. 04/05/00

Figure 2

Lancaster Laboratories
2425 New Holland Pike • Lancaster, PA 17601

Preparation of 525 Spikes and Special Mixes

Compound/Mix	Lot #	Exp. Date	Vendor	Density g/mL	%Purity	Initial Conc. ppm	Actual Amount	Final Conc ppm	Solvent	Location

Brought to a final volume _____ in $MeCl_2$ Lot # _____

Comments: _____

_____

Prepared by: _____ Date: _____

Compound/Mix	Lot #	Exp. Date	Vendor	Density g/mL	%Purity	Initial Conc. ppm	Actual Amount	Final Conc. ppm	Solvent	Location

Brought to a final volume _____ in $MeCl_2$ Lot # _____

Comments: _____

_____

Prepared by: _____ Date _____

2882 04/19/00

Figure 3

Lancaster Laboratories

Preparation of Working Stock

Date: _____ Working Stock ID: _____

Mix/Compound	Lot #	Exp. Date	Conc. (ppm)	µL	Final Conc.

Final Volume: _____ Solvent: _____ Solvent Lot #: _____ Stock Exp: _

Comments:

_____

_____

_____

_____

_____

_____

Prepared By: _____

1395 Rev. 04/05/00

Figure 4

Lancaster Laboratories

Preparation of 525 Working Stock

Date: _____ Working Stock ID: _____

Mix/Compound	Lot #	Exp. Date	Conc. (ppm)	µL	Final Conc.

Final Volume: _____ Solvent: _____

Stock Exp: _____ Solvent Lot # _____

Comments:

_____

_____

_____

_____

_____

Prepared By: _____

2883 04/26/00

Figure 5

Lancaster Laboratories

Preparation of Calibration Standards

Standard ID:	Lot #	Exp Date	Conc ppm						
Internal Std									
Final Volume in $MeCl_2$									

Comments: _____

Prepared by: _____ Date: _____

Preparation of Calibration Standards

Standard ID:	Lot #	Exp. Date	Conc. ppm						
Internal Std									
Final Volume in $MeCl_2$									

Comments: _____

Prepared by: _____ Date: _____

1381 Rev. 04/05/00

Figure 6

Lancaster Laboratories

Preparation of 525 Calibration Standards

Standard ID: _____	Lot #	Exp. Date	Conc. ppm						
Internal Std									
	Final Volume in Ethyl Acetate								

Comments: _____

_____

Prepared by: _____ Date: _____

Preparation of 525 Calibration Standards

Standard ID: _____	Lot #	Exp Date	Conc. ppm						
Internal Std									
	Final Volume in Ethyl Acetate								

Comments _____

_____

Prepared by: _____ Date: _____

2004 04/19/00

Appendix B
Chain-of-Custody

Honeywell Chain Of Custody / Analysis Request

AESI Ref: 38449.41045
COC # :
Lab Use Only
Lab Proj #
Lab ID

Privileged & Confidential
EDD To:
Site Name:
Location of Site:

Client Contact: (name, co., address)

Sampler:
P O #
Analysis Turnaround Time:
Standard -
Rush Charges Authorized for -
2 weeks -
1 week -
Next Day -

Hardcopy Report To:
Invoice To:

Preservative

PAGE 1 of
Job No

What is in the Text File? Mouse over here.

Written and maintained by AESI (Ver 3_7) 02-01-05 (eneSurgi@aol.com)

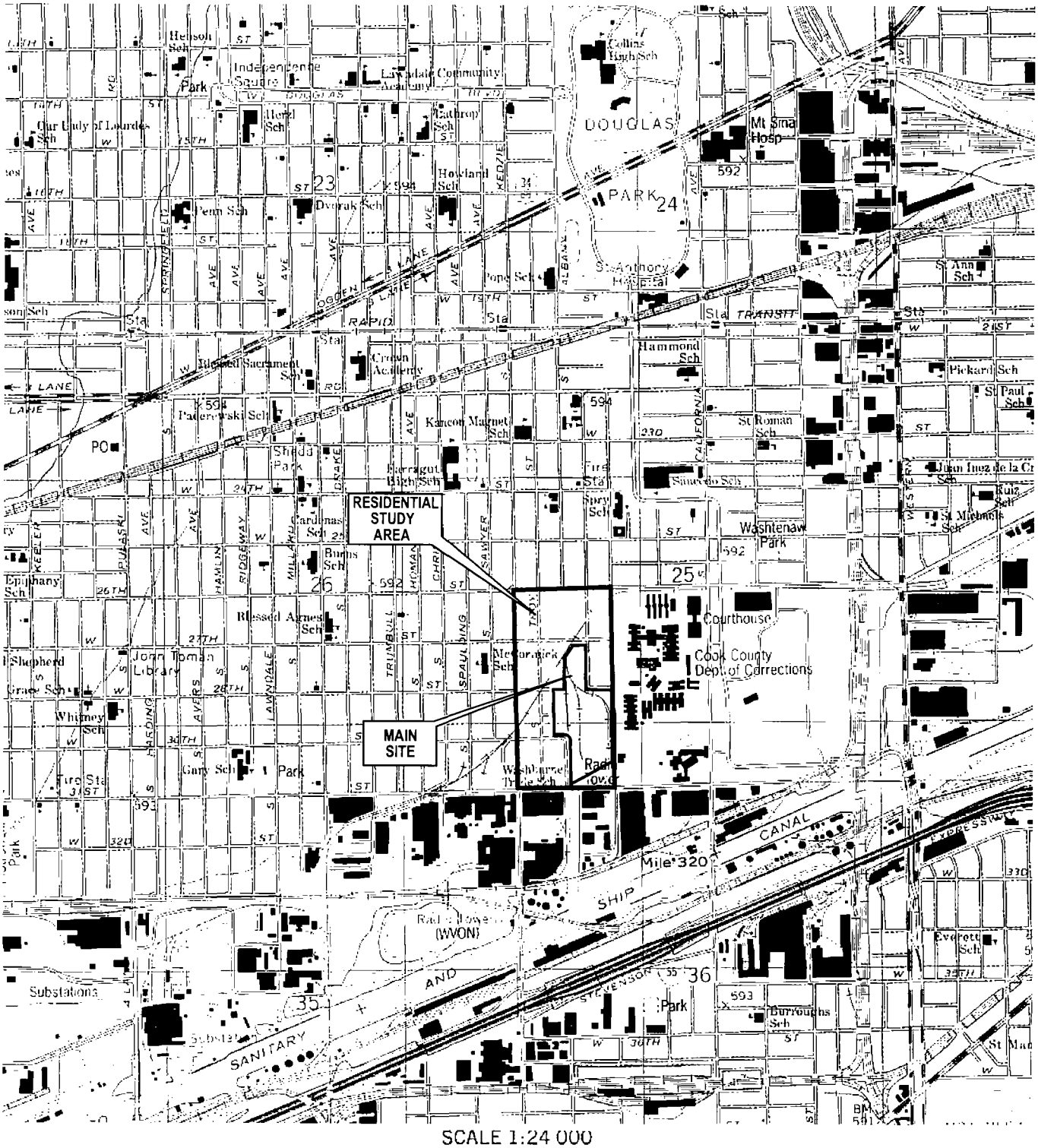
Sample Identification				Sample Date	Sample Time	Sample Type	Sample Matrix	Sample Purpose	# of Cont.	Grab/Composite	Field Filtered Sample ?														Lab Sample Numbers
	Location ID	Start Depth (ft)	End Depth (ft)	Field Sample ID																					
										Units															
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									
9																									
10																									
11																									
12																									

Relinquished by	Company		Received by	Company		Condition		Custody Seals Intact	
	Date/Time			Date/Time		Cooler Temp.			
Relinquished by	Company		Received by	Company		Condition		Custody Seals Intact	
	Date/Time			Date/Time		Cooler Temp.			

Preservatives: 0 = None; [1 = HCL]; [2 = HNO3]; [3 = H2SO4]; [4 = NaOH]; [5 = Zn. Acetate]; [6 = MeOH]; [7 = NaHSO4]; 8 = Other (specify):

Appendix C

Site Location Map and Aerial Photograph



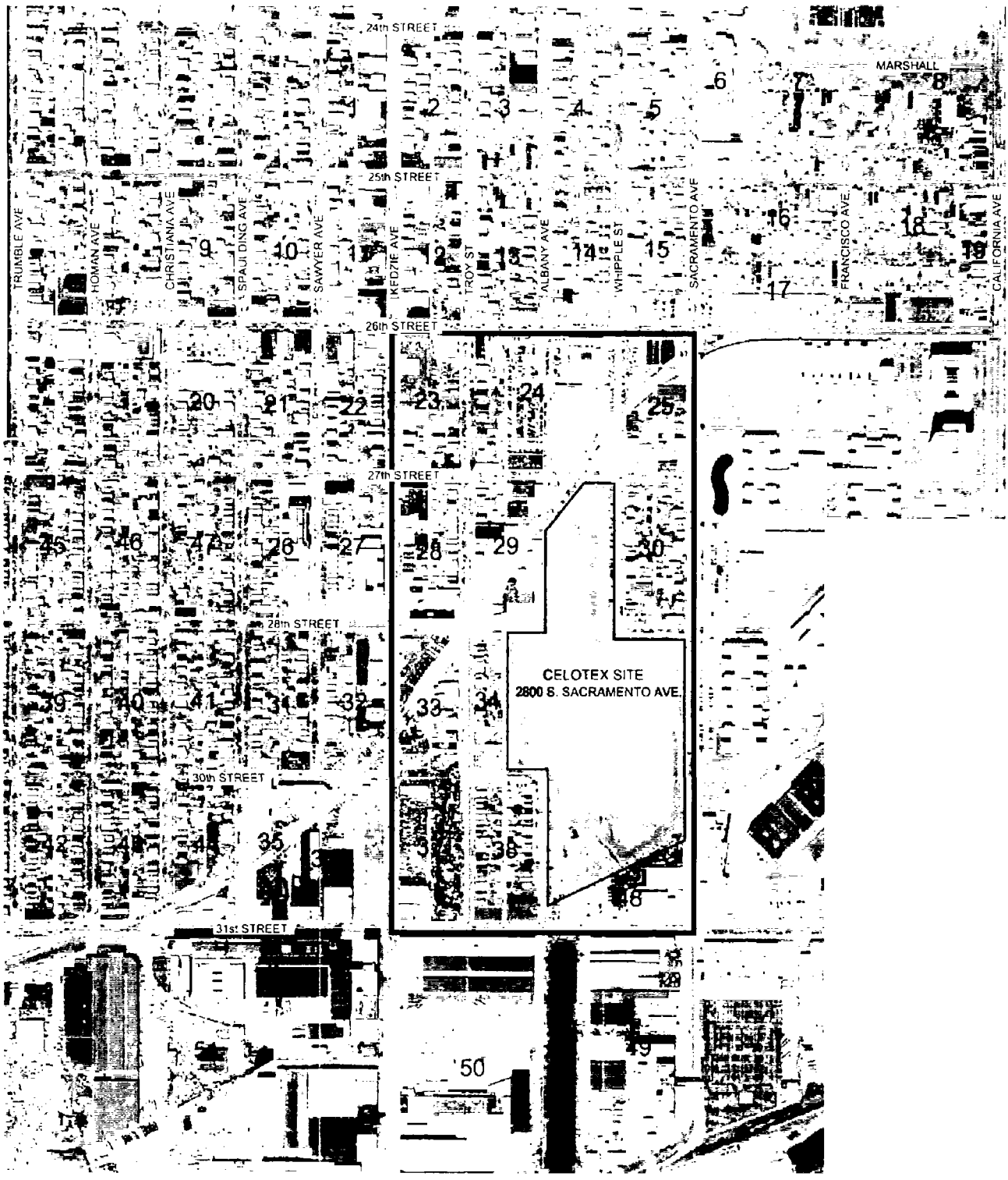
Source: U.S.G.S 7.5-Minute Quadrangle for Englewood, Illinois, 1997

Figure 1-1

Site Location and Study Area
Residential Soil Sampling Work Plan
Former Celotex Site
Chicago, Illinois

E327757 CE 10.1 Fig_1-1_Celotex_042106_v4 06-19-06 lg/jls

CH2MHILL



LEGEND

27	Block Number
	Northing and Easting Lines
———	Main Site
	Northeast Residential Area
- - - - - -	Southwest Residential Area
▬▬▬	Residential Sampling Area

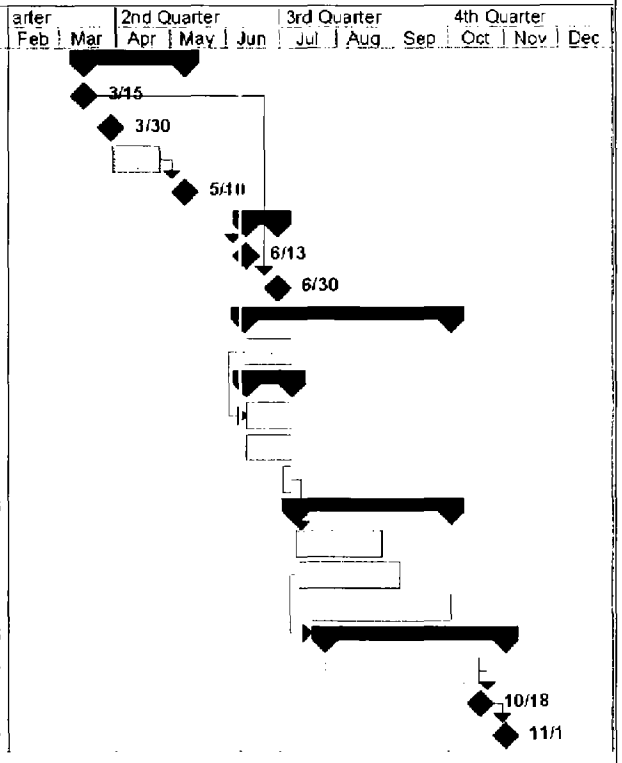
NOTE: Soil sampling within the Northeast and Southwest Residential Areas is required by USEPA. Honeywell has voluntarily agreed to perform residential soil sampling within the larger area identified as the Residential Study Area.

Figure 1-2
Aerial Photograph
Residential Soil Sampling Work Plan
Former Celotex Site
Chicago, Illinois

Appendix D
Project Schedule

Figure 5-1
Proposed Project Schedule
Residential Soil Sampling Work Plan
Former Celotex Site
Chicago, Illinois

ID	Task Name	Duration	Start	Finish
1	**Draft Residential Soil Sampling Work Plan**	**40 days**	**Wed 3/15/06**	**Wed 5/10/06**
2	Submit Draft Work Plan to USEPA	0 days	Wed 3/15/06	Wed 3/15/06
3	Receive USEPA Comments	0 days	Thu 3/30/06	Thu 3/30/06
4	Revise Work Plan for Community Distribution	18 days	Fri 3/31/06	Tue 4/25/06
5	Receive Community Responses	0 days	Wed 5/10/06	Wed 5/10/06
6	**Final Residential Soil Sampling Work Plan**	**13 days**	**Tue 6/13/06**	**Fri 6/30/06**
7	Submit Final Work Plan to USEPA	0 days	Tue 6/13/06	Tue 6/13/06
8	Obtain USEPA Approval	0 days	Fri 6/30/06	Fri 6/30/06
9	**Implement Residential Sampling Work Plan**	**81 days**	**Mon 6/12/06**	**Mon 10/2/06**
10	Verify Access Agreements	20 days	Mon 6/12/06	Fri 7/7/06
11	**Complete Initial Site Visits (179 Properties)**	**19 days**	**Tue 6/13/06**	**Fri 7/7/06**
12	Document Current Property Conditions	19 days	Tue 6/13/06	Fri 7/7/06
13	Layout Sample Locations	19 days	Tue 6/13/06	Fri 7/7/06
14	Utility Clearance	5 days	Mon 7/3/06	Fri 7/7/06
15	**Sampling and Analysis**	**61 days**	**Mon 7/10/06**	**Mon 10/2/06**
16	Collect Soil Samples (2 field teams)	35 days	Mon 7/10/06	Fri 8/25/06
17	Analyze Soil Samples (1068 composite samples)	39 days	Wed 7/12/06	Mon 9/4/06
18	Data Validation/Evaluation (PAHs)	54 days	Wed 7/19/06	Mon 10/2/06
19	**Prepare Residential Sampling Report**	**71 days**	**Wed 7/26/06**	**Wed 11/1/06**
20	Develop Residential Sampling Report	60 days	Wed 7/26/06	Tue 10/17/06
21	Submit Residential Sampling Report to USEPA	0 days	Wed 10/18/06	Wed 10/18/06
22	Receive USEPA Comments/Approval	0 days	Wed 11/1/06	Wed 11/1/06



Project: Celotex_Schedule_FINAL_060906.mpp
Date: Fri 6/9/06

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

Page 1